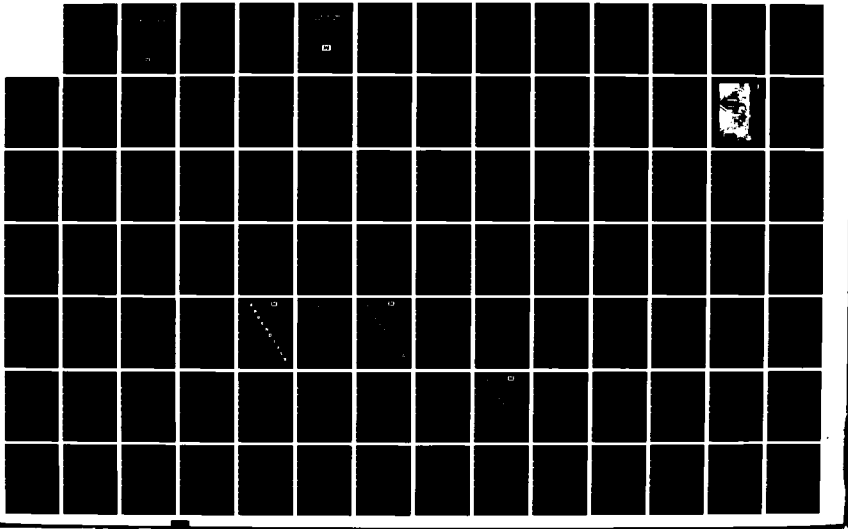
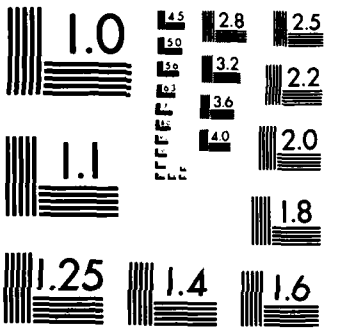
AD-A132 224 COW CASTLE CREEK ORANGEBURG COUNTY SOUTH CAROLINA 1/2
ENVIRONMENTAL ASSESSMENT(U) CORPS OF ENGINEERS
CHARLESTON SC CHARLESTON DISTRICT JUL 83

UNCLASSIFIED F/G 13/2 NL





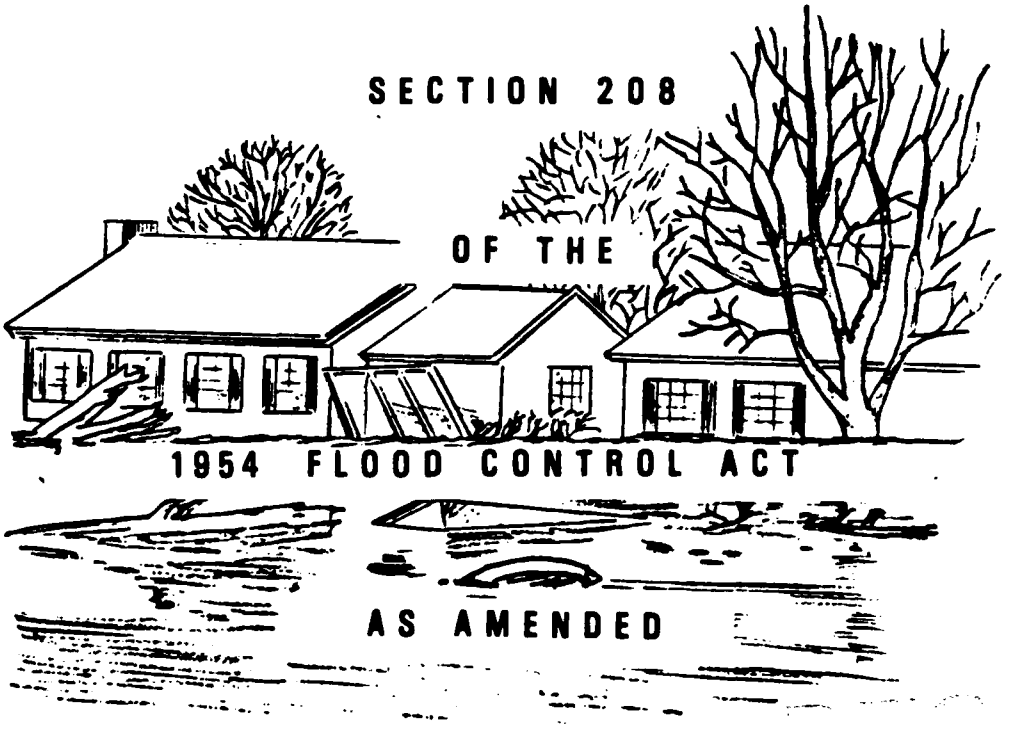
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(12)

FINAL REPORT
AND ENVIRONMENTAL ASSESSMENT

COW CASTLE CREEK

ORANGEBURG COUNTY
SOUTH CAROLINA



US Army Corps
of Engineers
Charleston District
JULY 1983

Do not destroy this report when no longer needed. Return it to the originator.

The contents of this report are not to be used for advertising, publication or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A132 224	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Cow Castle Creek, Orangeburg County, S. C. Final Report and Environmental Assessment		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Corps of Engineers, Charleston District P. O. Box 919, Charleston, S. C. 29402		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Corps of Engineers Office Chief of Engineers Washington, D. C. 20314		12. REPORT DATE May 1983
		13. NUMBER OF PAGES 114
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)* U. S. Army Corps of Engineers South Atlantic Division 30 Pryor Street, S.W. Atlanta, Georgia 30303		15. SECURITY CLASS. *(of this report)* Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution unlimited; Approved for Public Release

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Prepared in cooperation with Orangeburg County Council, Orangeburg, South Carolina, and the U. S. Fish and Wildlife Service

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Flood Control
Environmental Impacts

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Report of investigations to determine feasibility of providing flood control and related water resources improvements on various streams within the Cow Castle Creek Watershed, Orangeburg County, South Carolina. The report recommends construction of a combination of structural and non-structural flood damage prevention measures and discusses the impacts of implementation.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

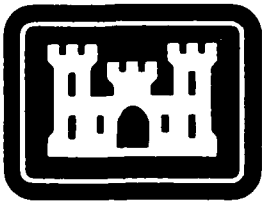
Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

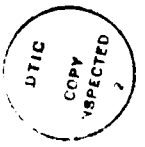
COW CASTLE CREEK

ORANGEBURG COUNTY, SOUTH CAROLINA

A study to determine the feasibility of providing flood control and related water resource improvements on Cow Castle Creek, Orangeburg County, South Carolina



US Army Corps of Engineers
Charleston District



SYLLABUS

The purpose of this study was to investigate flood problems associated with high flows in Cow Castle Creek, Orangeburg County, South Carolina, with a view to determine the needs for and feasibility of improvements to solve the flood problems. The study was conducted in response to a request by the Orangeburg County Council.

Cow Castle Creek is located entirely within the limits of Orangeburg County, South Carolina. Flood waters from the creek result in damages estimated to average $32,300 annually to existing development. A number of potential alternatives for flood damage reduction were investigated, but as the study progressed some of these methods proved to be impractical or engineeringly unsound. A combination of structural and nonstructural flood control measures has been determined to be the best solution for the Cow Castle Creek problems.

The selected plan of improvement to provide a degree of protection to the Cow Castle Creek Basin would involve approximately 1.5 miles of clearing and snagging plus cleanout of the Even Branch tributary at an estimated first cost of $158,000 and an estimated average annual cost of $17,000. The recommended project restricts the clearing of vegetation in such a way that the overall environmental impacts are judged to be minimal; therefore, no EIS is required.

Average annual cost of $17,000 when compared to annual benefits of $22,850 yields a benefit-to-cost ratio of 1.34 to 1.

COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA

DETAILED PROJECT REPORT

TABLE OF CONTENTS

COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA

DETAILED PROJECT REPORT

TABLE OF CONTENTS (Cont'd)

COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA

DETAILED PROJECT REPORT

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

FIGURES

COW CASTLE CREEK

ORANGEBURG COUNTY, SOUTH CAROLINA

DETAILED PROJECT REPORT

Introduction

AUTHORITY

This detailed project report is submitted under authority of Section 208 of the 1954 Flood Control Act, as amended, and in accordance with instructions contained in ER 1105-2-10 dated 5 February 1982. Subject report was initiated by letter dated 14 October 1981 to the South Atlantic Division Engineer, subject, "Cow Castle Creek, Orangeburg County, South Carolina." The Orangeburg County Council requested a flood control study by letter to the District Engineer dated 7 April 1981 (see Appendix D).

PURPOSE AND SCOPE

The purpose of this report is to present an evaluation of data concerning flooding along Cow Castle Creek, and to make recommendations for alleviation of flood damages and for the development of allied water resource purposes based on present and future needs. Its scope is confined to an analysis of the hydrologic, hydraulic, economic, environmental, and social aspects of flooding, and to an evaluation of engineering and administrative alternatives for the reduction of flood damages in Cow Castle Creek, Orangeburg County, South Carolina. The selection of the recommended plan was made after careful consideration of all factors, including those expressed by concerned agencies and local interests.

STUDY PARTICIPANTS AND COORDINATION

The Charleston District, Corps of Engineers, had the principal responsibility for conducting and coordinating the subject study. Orangeburg County, the local sponsoring organization, participated extensively throughout the development and preparation of this report. Coordination with Federal, State, and local agencies was maintained during the study and comments received are presented in Appendix D. Local residents along and around Cow Castle Creek who experienced repeated flood damage were interviewed in the field. Other pertinent data were provided by real estate appraisers, surveyors, and others as required.

PRIOR STUDIES AND REPORTS

Flood Insurance Studies have been completed for Orangeburg County and the City of Bowman, South Carolina, by the Flood Insurance Administration. Data obtained during those studies was used to supplement the data obtained by this office for use in the hydrologic and hydraulic study portions of this report.

EXISTING PROJECTS

Dredging work was done in Cow Castle Creek in 1944 by the Santee Construction Company (later called the Calhoun Construction Company) under contract to the Cow Castle Water District of Orangeburg County with the work being paid for by local taxation. Little indication of this past work remains visible today. There are no State or Federally-funded flood control projects for Cow Castle Creek.

Resources and Economy Of The Study Area

GENERAL DESCRIPTION

Cow Castle Creek is located in the Central part of Orangeburg County. The stream flows in a southeastward direction, roughly parallel to U. S. Highway 178, from its headwaters in the City of Orangeburg to the vicinity of Bowman, South Carolina. From this point, the stream curves gently eastward to its confluence with Four Hole Swamp, about midway between Bowman and Holly Hill, South Carolina. The creek nearly parallels U. S. Highway 178 (upstream of Bowman) and South Carolina Route 210 (downstream

of Bowman). Streams tributary to Cow Castle Creek include Crum Branch, Buck Branch, Even Branch, and several smaller streams (See Figure 1). Interstate Highway 26 crosses Cow Castle Creek about 1.5 miles above its confluence with Four Hole Swamp. The creek also is crossed by S. C. Route 210 near the eastern city limit of Bowman, South Carolina, and by numerous secondary roads throughout its length.

The total drainage area of Cow Castle Creek above its confluence with Four Hole Swamp is 57.5 square miles. Of this total, 23.4 square miles is located above the USGS stream gaging Station No. 0217425 near Bowman which was operated from 1970 to 1980.

Topography of the basin is typical of the Coastal Plain Region, being relatively flat, with surface elevations ranging between 100 and 200 feet, NGVD.

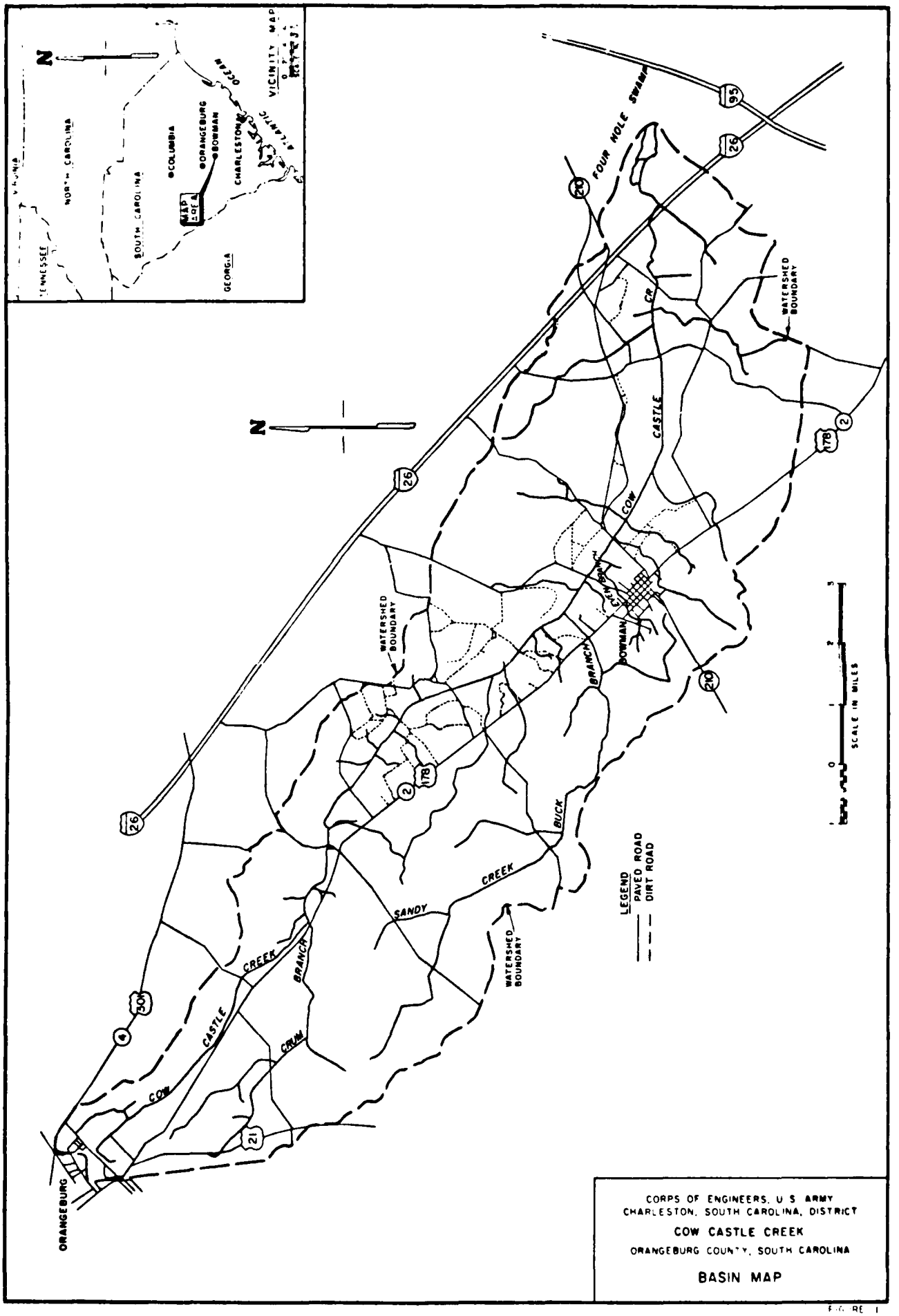

VICINITY MAP
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
COLUMBIA
ORANGEBURG
BOWMAN
CHARLESTON
OCEAN
MAP 1 OF 4
N
FOUR HOLE SWAMP
COW CASTLE CR
WATERSHED BOUNDARY
COW CASTLE CREEK
BOWMAN BRANCH
BUCK CREEK
SANDY CREEK
CRUM BRANCH
ORANGEBURG
SCALE IN MILES
LEGEND
PAVED ROAD
DIRT ROAD
CORPS OF ENGINEERS, U S ARMY
CHARLESTON, SOUTH CAROLINA, DISTRICT
COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA
BASIN MAP

FIGURE 1

DESCRIPTION OF THE STUDY AREA

For the purpose of this report, the portion of Cow Castle Creek below the Federal jurisdictional limit (that point where the 10-year frequency flow equals or exceeds 800 cubic feet per second) downstream to Four Hole Swamp was studied. The major damage areas are at Bowman and along U. S. Highway 178 and S. C. Route 210.

The study area experiences mild winters and hot summers. Temperatures drop below freezing on about 45 days per year, but rarely drop to zero degrees fahrenheit. Temperatures reach 90° fahrenheit on about 80 days per year. The area receives about 47 inches of precipitation per year.

HISTORIC BACKGROUND

The City of Bowman, located about 14 miles southeast of Orangeburg, was founded about 1887; and was named for the Bowman family, from whom the land was purchased. Lumbering played a major role in the early growth of the City, and one of the first industries was a saw mill. Later, the B and B. Railroad was built to connect Bowman and Branchville, facilitating the shipment of lumber to market. The development of agriculture in the area added new industries. While there is still a lumber company operating in Bowman, and a shirt factory has been constructed, the area is now primarily an agricultural community. Many homes, churches, and commercial structures have been built within the City.

The population of Bowman has remained relatively stable for the past 20 years, increasing from 1,106 persons in 1960 to 1,137 persons in 1980. During the same period, the population of the larger Bowman Census Division increased from 3,960 persons to 4,339 persons, an increase of 9.6 percent. The population of Orangeburg County increased from 68,559 persons in 1960 to 82,276 persons in 1980, a larger increase of 20.0 percent (see Table 1).

TABLE 1

HISTORICAL POPULATION

	1950[1/]	1960[1/]	1970[2/]	1980[2/]
City of Bowman	857	1,106	1,095	1,137
Bowman Census Division	N.A.[3/]	3,960	3,565	4,339
Orangeburg County	68,726	68,559	69,789	82,276
South Carolina	2,117,027	2,382,594	2,590,713	3,119,208

1/ U.S. Department of Commerce, Bureau of the Census, United States Census of *Population*, South Carolina, Number of Inhabitants, 1950 and 1960.

2/ U. S. Department of Commerce, Bureau of the Census, Advance Reports, 1980 Census of Population and Housing, South Carolina, Final Population and Housing Unit Counts.

3/ N.A. - Not Available.

The main industry in the Bowman area is Agriculture. The principal crops are corn and soybeans (see Table 2). Crops of lesser importance include cotton, hay, wheat, sorghum, and vegetables. Farm animals produced in the area include hogs (and pigs), cattle (and calves), and poultry.

TABLE 2

AGRICULTURAL STATISTICS

ORANGEBURG COUNTY (1974)

CROPS	FARMS		ACREAGE	
	No.	%	No.	%
Field Corn	1,100	33.13	63,168	32.53
Sorghum	58	1.75	1,421	0.73
Soybeans	1,142	34.40	94,471	48.65
Hay	331	9.97	8,220	4.23
Cotton	213	6.42	17,810	9.17
Tobacco	17	0.51	109	0.05
Irish Potatoes	44	1.32	160	0.08
Vegetables, Sweet Corn, Melons	185	5.57	1,748	0.90
Orchards	42	1.26	1,233	0.63
Peanuts for Nuts	42	1.26	47	0.02
Wheat	146	4.40	5,809	3.00
TOTALS	3,320	100.00	194,196	100.00

	FARMS	NUMBER
Hogs and Pigs (Inventory)	655	51,720
Cattle and Calves (Inventory)	626	31,617
Poultry (Inventory)	252	148,965
Horses and Ponies	113	368
Sheep and Lambs	2	34
TOTALS	1,648	232,704

SOURCE: U.S. Department of Commerce, Bureau of the Census, 1974 Census of Agriculture, South Carolina, Vol. 2, Part 40, June 1977

Industries located within the City of Bowman in 1976 included a manufacturing plant, a lumber mill and a logging company. These industries employed 166 persons. By census count, the City had 408 housing units in 1980. Several commercial establishments are located in Bowman. Per capita income in Orangeburg County in 1979 was $5,913 (see Table 3).

TABLE 3

PER CAPITA PERSONAL INCOME[1/]

	YEARS					
	1974	1975	1976	1977	1978	1979
Orangeburg County	3,744	3,945	4,294	4,606	5,211	5,913
South Carolina	4,407	4,665	5,179	5,675	6,340	7,056
United States	5,428	5,861	6,401	7,035	4,846	8,757

1/ U. S. Department of Commerce, Bureau of Economic Analysis, Local Area Personal Income 1974-1979, Volume 6, Southeast Region.

SOILS

No soils testing or laboratory classification was done for this report. Field observations indicate that sand is the predominant soil type with varying amounts of silt. Quantities of these soils have formed minor shoals within the channel due to the presence of fallen trees and other debris.

LAND USE

Two principal highways pass through the City of Bowman. These are U. S. Highway 178 and S. C. Highway 210. The main commercial street of Bowman (U. S. Highway 178) is constructed along a ridge. Residences and some commercial structures are located on each side of this ridge which runs in a northwest-southeast direction. S. C. Highway 210 crosses the southern part of Bowman approximately perpendicular to U. S. Highway 178. The total estimated acreage within the City of Bowman is about 660 acres, most of which is developed. The undeveloped acreage includes small farms, woodlands, and drainage features.

ENVIRONMENTAL CONSIDERATIONS

Cow Castle Creek Basin is located within the larger Edisto River Basin in Orangeburg County between Four Hole Swamp and the City of Orangeburg. The major study emphasis is at and below the City of Bowman, a small town bordered by farmlands. Cow Castle Creek originates in the City of Orangeburg and flows generally southeast past Bowman into Four Hole Swamp which empties into the Edisto River. Several small tributaries enter Cow Castle Creek, adding to its flow during storms and hurricanes. Siltation and extensive litter and log obstructions in the lower reaches of Cow Castle Creek cause flooding in and around Bowman during high flow periods.

Vegetation occurring within the study area is typical of southern Coastal Plain flora. Overstory species predominating include Sweetgum, Blackgum, Yellow Poplar, Sycamore, Water Oak, Willow Oak, Loblolly Pine, and Long Leaf Pine. Understory and ground cover species predominating include

Dogwood, Privet, Honeysuckle, Poison Ivy, Virginia Creeper, Rushes and Plantains. The predominant aquatic species within Cow Castle Creek are Duckweed and Alligator Weed. Smartweed dominates the various bridge abutments at the creek crossings.

All wildlife species which occur in a typical suburban, farmland, upper Coastal Plain stream, bottom land, habitat can be expected to occur in the Cow Castle Creek study area. No unusual or critical terrestrial habitat appears in the study area.

Cow Castle Creek is a shallow, narrow stream which supports a fair-to-good fishery. The stream bottom consists of a sandy-silt base.

There are no known endangered or threatened species in the study area. Furthermore, there does not appear to be any potential for adversely affecting any endangered or threatened species. There is no critical habitat in the study area for any endangered or threatened species.

CULTURAL RESOURCES

The National Register of Historic Sites does not list anything within the study area. There are no known archaeological sites of significance within the study area. The reconnaissance survey did not reveal any cultural resources not listed on the National Register.

Problem Identification

The following paragraphs discuss the water resources needs and problems in the Cow Castle Creek Basin. Preliminary investigations indicated that the major problems and needs are confined to flooding. Also, there is the need to enhance and preserve the environment.

NATIONAL OBJECTIVES

The objective of the multi-objective planning framework is to guide planning for the conservation, development, and management of water and related land resources. National Economic Development (NED) and Environmental Quality (EQ) are established national objectives.

Activities such as flood control and prevention, flood plain management, drainage, prevention of sedimentation, land stabilization, and erosion control can contribute to these objectives by improving the productivity, use, and attractiveness of the Nation's natural resources. From the viewpoint of NED, the effect of these activities on the output of goods and services is manifested by increasing the productivity of land or by reducing the costs of using land resources, thereby releasing resources for production of goods and services elsewhere. Land resources are enhanced by the prevention of damage resulting from inadequate drainage.

The EQ aspects of the project address the need to harmonize the land use objectives with the conservation of the creek's natural resources. The preservation of the existing biological and ecological systems is an equal partner with the other purposes of this Federal water project.

EXISTING PLANS AND IMPROVEMENTS

There are no existing or pending projects being considered on Cow Castle Creek by county, state, or by Federal agencies other than the Corps of Engineers.

PROBLEMS AND NEEDS

The problems and needs of Cow Castle Creek Basin discussed in this report are primarily concerned with flood damages that occur in Bowman, South Carolina. Cow Castle Creek and its tributary, Even Branch, frequently flood causing damage to residential and public properties. About 26 single family residential structures, six mobile homes, a lumber mill, church and two additional commercial structures are subject to flooding by overflow from these two creeks. Floods result from inadequate conveyance capacity for storm discharges. Obstructions that adversely affect flood stages are classified as man-made and natural obstructions. Man-made obstructions in the channel and flood plain areas include bridges, culverts, dams, buildings, dumps, land fills, and stored material. Trees, brush, and grass that grow along the creek are examples of natural flow obstructions. This natural growth, plus some fallen trees, accumulated waterborne debris, and associated minor shoaling combine to cause the reduced conveyance capacity in Cow Castle Creek.

Much concern has been expressed by citizens of Orangeburg County and Bowman, South Carolina, about the health hazards as well as the property damage resulting from the frequent flooding in the Cow Castle Creek Drainage District. The flood damages, primarily in and around the City of Bowman, are the result of backwaters into the tributaries caused by the creek's inability to readily empty into Four Hole Swamp. This condition of retarded flow results in significant flood damage and, in addition, pre-

vents proper discharge of the local septic tanks, thus endangering the local water system by polluting the elevated ground water table.

On 20 January 1978, an imminent hazard was declared for Bowman due to the heavy presence of coliform bacteria in the drinking water supply. The residents were instructed to boil the water before drinking, while an emergency chlorinator was being connected to the system. The South Carolina Department of Health and Environmental Control (DHEC) was not able to establish that any one problem had caused the contamination. Local residents, however, believe that the major contributing factor was the elevated water table which resulted from local flooding. Sampling of the water supply by DHEC continues; although the "boil-water" notice was lifted on 2 February 1978, when the samples indicated that coliform bacteria were no longer present in the Bowman system.

FLOOD DAMAGES

Flood damages along Cow Castle Creek consist of both tangible and intangible damages. Tangible damages are those subject to monetary evaluation and include: physical damages or losses to property and improvements; emergency cost for flood damage prevention; and, business, financial, and wage losses in and adjacent to the flooded areas. Intangible damages are not susceptible to monetary evaluation and include: danger to human life; added inconvenience and human discomfort; injury and exposure during floods; creation of conditions detrimental to health and security, interruption of traffic, utility services, and normal community activities; and, the detrimental effects of frequent flooding on the appearance and aesthetic quality of the flood plain such as deposition of debris, etc.

Flooding along Cow Castle results from overbank flows which inundate roadways and residential properties. This problem becomes more acute each year

as new development takes place in the watershed area. Damage to structures include the physical damage to buildings, heating and cooling systems, electrical installations, other fixed or built-in equipment and items included therein. Contents subject to damage include such items as floor covering, appliances, household furnishings, clothing and items of personal property. Streets and residential areas of Bowman are frequently flooded, and portions of the main highways near the tributaries of the creek are reported to have been impassably inundated (see Figure 2). In addition to the structural damage, crops are adversely affected on each side of the creek and on many of its tributaries.

In order to assess economic damages, first floor elevations of flood plain structures were determined. Flood damage computations took into consideration the relationship of structures to stages for selected frequency events. A computer program for the Economic Analysis of alternative plans considered provided damage estimates for existing and improved conditions. Program options permit the assessment of various plans of improvement including both structural or nonstructural measures. The program analyzes individual buildings to determine the expected depth of flooding for various flood events with selected recurrence intervals. Based on the expected depth of flooding in relation to the first floor elevation, an expected damage to the building and its contents was computed utilizing data for the type of building, its value, and predetermined depth-damage relationships. Single occurrence events were combined through the use of probability analyses to provide the average annual damage that would be expected from given flood conditions for that building.

The amount of monetary damages resulting from a flood on Cow Castle Creek is related to the stage experienced. As flood stages increase, resulting flood damages increase. Table 4 shows the expected amount of monetary damages which would occur for various flood events based on existing stream conditions and 1983 dollar values. Flood events are defined by their

expected frequency of occurrence (i.e., a 2-year frequency flood would occur on the average of once every two years with a 50% probability of occurring during any given year).

TABLE 4

PROJECTED FLOOD DAMAGES - EXISTING CONDITIONS
COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA

Flood-Frequency	TOTAL DAMAGES (1983 $)		
	COW CASTLE	EVEN BRANCH	TOTAL
2-Year	4,100	19,800	23,900
10-Year	26,200	32,600	58,700
25-Year	80,500	44,600	125,100
50-Year	116,700	77,600	194,300
100-Year	150,800	101,200	252,000
500-Year	296,400	144,400	440,800

AVERAGE ANNUAL DAMAGES

Monetary damages caused by the flooding of Even Branch and Cow Castle Creek in the immediate vicinity of Bowman are estimated to average $12,300 annually on Cow Castle Creek and $20,000 annually on Even Branch. Total annual flood damages are estimated to be $32,300. Table 5 summarizes estimated average annual damages by area and category. Further detailed information and a description of computational procedures are contained in Appendix B to this report.

RESIDENTIAL FLOODING AT BOWMAN, SOUTH CAROLINA
HURRICANE "DAVID" SEPTEMBER 1979

Figure 2

TABLE 5

AVERAGE ANNUAL EQUIVALENT DAMAGES
COW CASTLE CREEK AND EVEN BRANCH
ORANGEBURG COUNTY, SOUTH CAROLINA

DAMAGE CATEGORY	ESTIMATED ANNUAL EQUIVALENT DAMAGES (1983 X 1000; i = 7-7/8%) COW CASTLE CREEK	EVEN BRANCH	TOTAL DAMAGE REACH
Residential			
Structural	$ 6.90	$12.93	$19.83
Content	1.76	1.43	3.19
Other	1.86	2.48	4.34
SUBTOTAL RESIDENTIAL	$10.52	$16.84	$27.36
Commercial			
Structural	$ 0.13	$ 2.58	$ 2.71
Content	0.05	0.44	0.49
Other	0.01	0.10	0.11
SUBTOTAL COMMERCIAL	$ 0.19	$ 3.12	$ 3.31
Industrial			
Structural	$ 0.40	$ 0.00	$ 0.40
Content	0.70	0.00	0.70
Other	0.52	0.00	0.52
SUBTOTAL INDUSTRIAL	$ 1.62	$ 0.00	$ 1.62
Total All Categories			
Structural	$ 7.43	$15.51	$22.94
Content	2.51	1.87	4.38
Other	2.39	2.58	4.97
TOTAL DAMAGES	$12.33	$19.96	$32.29

Condition If No Federal Action Is Taken

Although the Bowman community has experienced little growth in the past decade, growth is expected in the near future due to its proximity to Orangeburg. Rapid growth is taking place in both the City and County of Orangeburg. Growth of an area tends to aggravate existing problems such as flooding, unless preventive and/or corrective measures are established. Flood Insurance Studies have been conducted for both the City of Bowman and Orangeburg County, and both have entered the Flood Insurance Program. Participation in this program insures that measures will be taken to control development to avoid potential flood damages thereto.

Since the flow conveyance capacity of the creek continues to deteriorate,the potential for flood damage is expected to slowly increase with the passage of time into the foreseeable future if no action is taken.

Planning Constraints

Planning constraints inherent in the processing of a Section 208 investigation include a restriction of the mode of improvement implementable by the flood damage reduction authority. Section 208 only permits clearing and snagging of a stream in an effort to improve conveyance capacity. During reconnaissance investigations, other means of improvement were considered as discussed in subsequent sections of this report. The most feasible solutions, however, appeared to be clearing and snagging, thus a decision was made to process study through Section 208 authority. Other planning constraints revolved around the actual work methods to be employed in a clearing and snagging operation and the economic viability of the project. Procedures used to clear the stream and to remove obstructions were evaluated to minimize impacts on the wildlife resource and scenic qualities found along the stream banks.

Planning Objectives

Planning objectives from the national viewpoint are to enhance National Economic Development (NED) and/or Environmental Quality (EQ) of the nation. To accomplish this, the local planning objective is to restore the creek to its previous carrying capacity. This would provide a means of conveying flood flows at reduced stages and would reduce the damaging effects of creek overflow. Local planning objectives are to:

a. Reduce flood damages along Cow Castle Creek.
b. Preserve the natural appearance and beauty of the Creek.
c. Preserve the aquatic and terrestrial habitat.

Alternative Plans Considered

Several alternative measures to meet the problems and needs of the area are possible; however, some of these measures are not practical or economical. Possible solutions may be divided into two categories of structural and nonstructural. Structural measures are designed to modify floods by altering the natural environment. These measures include alternatives which reduce flood elevations, divert floods, change the timing and duration of floods or restrict floods from portions of the flood plain. Nonstructural measures are designed to modify flood damage susceptibility and include modifications to the cultural environment by adjustment in the pattern and mode of land use, by development policies and by assistance to affected individuals. Also, a combination of structural and nonstructural measures is possible.

STRUCTURAL MEASURES

The topography of the basin limits the number of approaches which would be effective. Structural measures considered during various phases of investigation included the following:

a. Reservoirs. Reservoirs provide a means for the storage for runoff during critical periods for later release in a manner that is not damaging. There are no suitable sites for the development of reservoirs, therefore, this approach was eliminated from further consideration.

b. Floodwalls and Levees. These measures prevent flood waters from entering damage susceptible areas. Their use would, however, conflict with

the use of the properties they would be designated to protect. This approach, therefore, was eliminated from further consideration.

c. Diversion. The diversion of flood waters into adjacent streams also was considered but due to the lack of a suitable receiving stream, this alternative was dropped.

d. Channel Conveyance Improvement. Channel conveyance improvements consist of various modifications to the existing channel which result in an increased flow capacity. These improvements include clearing, snagging, deepening, widening, and/or channel realignment. Reconnaissance studies determined that clearing and snagging was the only channel improvement alternative economically justified.

Since the flood problem in the Bowman area has been created by excessive amounts of vegetation, silt and debris which restrict the effectiveness of the natural channel, removal of these flow restrictions by clearing and snagging appeared to be the most effective means of approaching the problem. This type of solution would effectively restore the stream to its original flood carrying capacity. Clearing and snagging would not only alleviate the frequent problem of high water around and on adjacent lands, but would enhance the area for recreational use by sight-seers, sportsmen, and others who are attracted to a natural flowing stream. Some shelters and substrate for aquatic organisms would be lost, but with a few precautions damages to the biological productivity of the system can be minimized.

NONSTRUCTURAL MEASURES

Nonstructural measures do not attempt to reduce or eliminate flooding, but are to regulate the use and development of the flood plain, thus lessening damaging effects of large floods. Nonstructural solutions might include flood proofing, evacuation, open space development, restriction of building financing, flood insurance, urban development, and reconstruction or removal of bridges which restrict flow. These measures could effectively reduce or eliminate future damage in the flood plain.

a. Flood Proofing. This approach would prevent flood waters from penetrating structures through the placement of a water proof barrier or by raising the susceptible structure above the level of the 100-year flood or greater. Due to the lack of economic justification, this approach was dropped from serious consideration.

b. Flood Plain Evacuation. Flood plain evacuation would consist of the purchase and relocation or demolition of all structures with first floor elevations at or below a selected frequency flood. Structures involved in the implementation of an evacuation alternative would be purchased at fair market value and provisions would be made to resettle occupants at that time. Lands purchased during project implementation would be turned over to the local project sponsor for development in a manner compatible with flood plain use such as recreation facilities or environmental corridors. This type of solution is not economically viable for the problems experienced in Bowman.

c. Management Planning. After the flood hazard is defined, a community has a variety of measures that could be implemented and enforced to shape the future of the area, to protect life and property, and to improve environmental quality. Zoning, building codes, sanitary codes, and

building regulations are viable planning alternatives that could be enforced by the regulating agency to effectively reduce the flood damage risk on new development. There also are several approaches the community might take to reduce future flood losses to homes, businesses and industries already located in the flood plain. For example, the community should encourage participation in the National Flood Insurance Program. Other locally implementable nonstructural measures include: set up an advance flood warning and evacuation system; encourage voluntary flood proofing; encourage voluntary relocation out of the flood plain; encourage voluntary removal of debris from the flood plain; and, conduct a public education campaign to make flood hazard areas well known to developers, real estate firms, lending institutions and the general public.

COMBINED MEASURES

Thus far, structural and nonstructural alternatives have been considered separately. However, a combination of structural and nonstructural alternatives may provide the best solution to the flood problems on Cow Castle Creek. As previously discussed, nonstructural solutions are not sufficient to alleviate flood damages to existing structures. A structural alternative will be required to effectively reduce existing damages. Future devleopment, however, must be considered. Without some type of flood plain regulation, future development can encroach upon the flood plain and thus reduce the effectiveness of a flood control project. In consideration of the above, any recommended structural solution to the flood problems on Cow Castle Creek will be accompanied with the requirement that the local community establish and enforce flood plain regulations for the residual flood plain.

DO NOTHING ALTERNATIVE

This plan would have no Federal participation in corrective works. It is probable that channel conditions will deteriorate in the future resulting in increased damages from small floods. This would be true unless the local government or the property owners collectively move to solve the problem. There would be no monetary benefits or costs associated with doing nothing; however, damage would be expected to continue to take place at an increasing rate.

Plan Selection

Under Section 208 of the Flood Control Act of 1954, as amended, corrective works authorized and constructed are limited to clearing and snagging. Sufficient investigations of other alternatives were made which verified that clearing and snagging would be the best plan and that the study authority is the best one for addressing this particular problem. This type of improvement is cost effective and environmentally acceptable. It in effect makes the channel and near overbank area more efficient for flood conveyance. Greatest benefits would occur from damages prevented for the more frequent smaller floods. Implementation of a clearing and snagging project would also require a commitment from the local sponsor to regulate future development along the project reach to that which is compatible with the flood hazard.

Description Of The Selected Plan

The following pages present a brief description of the plan, considered to be the best solution to meet the study objective. The following discussions include a description of the expected accomplishments and effects of the selected plan. A detailed outline of the construction plan and maintenance program is found in Appendix C.

PLAN DESCRIPTION

The structural measures of the plan consist of the clearing and snagging of the existing channel of Cow Castle Creek for a total distance of 1.5 miles. Work would extend from a point about 3/4 miles below S. C. Highway 210, upstream for a total distance upstream of approximately 8,000 feet (See Figure 3). In addition to this clearing and snagging in the main channel of Cow Castle Creek, the Even Branch tributary which passes through the Town of Bowman must be cleaned out for a distance of approximately 1.7 miles to reestablish natural flows in order to provide maximum project benefits. The work in Even Branch would be the responsibility of the local sponsor since this tributary does not meet Federal criteria necessary to qualify for flood control assistance. All proposed work would be limited in scope in order to assure the preservation of scenic qualities along the stream banks, while still addressing the objective of increased channel efficiency. The limits of the work are shown on Figure 3 and on plates following Appendix A.

Total land requirements for the selected plan are estimated to be 37 acres. This is based on the acquisition of a 200-foot cleared width for a distance of about 8,000 feet. The clearing would extend from the top of the right creek bank 200 feet to the left, looking downstream. Snags, drift, and

other debris would be removed form the creek channel. Small trees and all brush would be removed from the entire cleared width. All larger trees, 12 inches or greater in diameter would be saved. Minor shoaling, which may have accumulated at the channel blockages, would be removed. The work in Even Branch would be limited to clearing of the debris between the existing banks and at culvert ends, etc., to reestablish free flow.

Nonstructural recommendations would require that the local sponsor enforce flood plain ordinances to assure that any future development of the residual flood plain would be compatible with the flood hazard. Continued participation in the Flood Insurance Program by residents living in flood-prone structures would also be required.

PROJECT COST

The estimated first cost for implementation of the selected plan is $158,000 consisting of a Federal expenditure of $132,000 and a non-Federal expenditure of $26,000. Average annual project costs are estimated to be $17,000 based on a 50 year life and an interest rate of 7 7/8%. Operation and maintenance costs of $4,300 annually are included in this figure. A summary of the first cost and annual charges for the selected plan is given in Table 6.

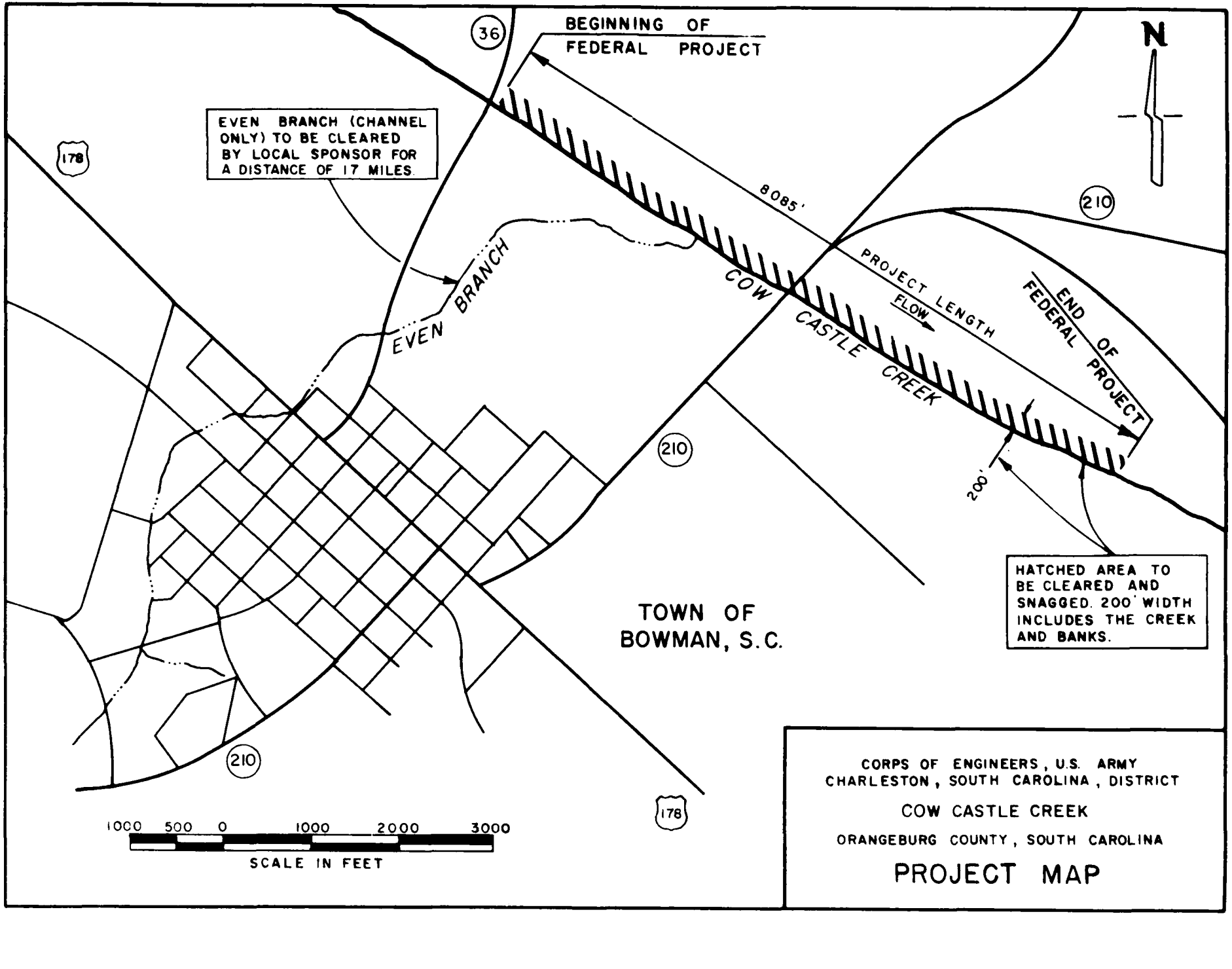

BEGINNING OF FEDERAL PROJECT
36
N
EVEN BRANCH (CHANNEL ONLY) TO BE CLEARED BY LOCAL SPONSOR FOR A DISTANCE OF 17 MILES.
178
8085'
210
PROJECT LENGTH
FLOW
END OF FEDERAL PROJECT
EVEN BRANCH
COW CASTLE CREEK
210
200'
HATCHED AREA TO BE CLEARED AND SNAGGED. 200' WIDTH INCLUDES THE CREEK AND BANKS.
TOWN OF BOWMAN, S.C.
210
178
1000 500 0 1000 2000 3000
SCALE IN FEET
CORPS OF ENGINEERS, U.S. ARMY
CHARLESTON, SOUTH CAROLINA, DISTRICT
COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA
PROJECT MAP

FIGURE 3

TABLE 6

SUMMARY OF PROJECT COST

ITEM	FEDERAL (COW CASTLE CREEK)	NON-FEDERAL (EVEN BRANCH)	TOTAL PROJECT TOTAL
	(FIRST COST - CONSTRUCTION)		
Mob. & Demob.	$ 5,000	$ 2,000	$ 7,000
Clearing and Snagging	63,000	4,300	67,300
Seeding	21,000	1,200	22,200
SUBTOTAL	$ 89,000	$ 7,500	$ 96,500
Contingencies	18,000	1,500	19,500
Engr. & Design	14,000	1,200	15,200
Super. & Admin.	11,000	800	11,800
CONSTRUCTION COST	$132,000	$11,000	$143,000
Lands (Easement)	-	15,000[1]/	15,000
TOTAL FIRST COST	$132,000	$26,000[1]/	$158,000
	(ANNUAL COST)		
Interest & Amort.	$ 10,700	$ 2,100	$ 12,700
Maintenance	-	4,300[2]/	4,300
TOTAL ANNUAL COST	$ 10,700	$ 6,400	$ 17,000

1/ Includes land cost for both Cow Castle Creek and Even Branch

2/ Maintenance estimates include estimates for Cow Castle Creek and Even Branch.

PLAN ACCOMPLISHMENTS

The major monetary benefit resulting from implementation of the selected plan stems from a reduction of flood stages. Flood damage reduction benefits would be realized for approximately 36 structures located within the existing flood plain. Estimated annual benefit to existing structures is approximately $22,350. An additional $500 annually would also be realized in the form of agricultural benefits for a total annual project benefit of $22,850. Table 7 summarizes expected project benefits. The plan eliminates about 70 percent of the combined existing damages. About 63 percent of the benefits for Even Branch could not be realized without the downstream work on Cow Castle Creek.

Profiles for both existing and improved conditions for various frequency floods and other pertinent hydraulic data are presented in Appendix A. Further detailed economic evaluations are presented in Appendix B.

In addition to the above described benefits, construction of a flood control project on Cow Castle Creek would reduce health hazards, particularly those created by the overflow of water onto low lying area. Other intangible benefits include reduction of risk to human life and limb, peace of mind that goes therewith, and reduction in traffic disruptions. This plan would have beneficial environmental effects in that it recommends the removal of trash, debris, and large discarded articles from the creek bottom, and the removal of vegetation which, in places, clogs the channel and collects floating debris and scum.

Adverse effects of the selected plan include a temporary increase in noise and air pollution during the construction phase, a temporary increase in siltation and turbidity during the construction phase, a minimal loss of fishery spawning and nursery habitat as a result of debris removal, and a change in wildlife use resulting from the clearing of approximately 37 acres of understory and ground cover vegetation. Due to the incorporation of U. S. Fish and Wildlife Service suggestions into the project plan, the above effects will be minimized and the biological productivity of the Cow Castle Creek system will not suffer any serious detrimental effects.

TABLE 7

PROJECT BENEFITS

CLEARING AND SNAGGING OF

COW CASTLE CREEK AND EVEN BRANCH

ORANGEBURG COUNTY, SOUTH CAROLINA

STREAM REACH	EXISTING DAMAGES ($1000)	RESIDUAL DAMAGES ($1000)	BENEFITS ($1000)
	RESIDENTIAL		
Cow Castle Creek	$10.52	$6.95	$ 3.57
Even Branch	16.84	1.43	15.41
SUBTOTAL RESIDENTIAL	$27.36	$8.38	$18.98
	COMMERCIAL		
Cow Castle Creek	$0.19	$0.11	$0.08
Even Branch	3.12	0.44	2.68
SUBTOTAL	$3.31	$0.55	$2.76
	INDUSTRIAL		
Cow Castle Creek	$1.62	$1.01	$0.61
Even Branch	0.00	0.00	0.00
SUBTOTAL INDUSTRIAL	$1.62	$1.01	$0.61
	AGRICULTURAL		
Cow Castle Creek	$0.80	$0.30	$0.50
	DAMAGE/BENEFIT SUMMARY		
Cow Castle Creek	$13.13	$ 8.37	$ 4.76
Even Branch	19.96	1.86	18.10
TOTAL	$33.09	$10.24	$22.85

TABLE 8

BENEFIT-TO-COST COMPARISON

CLEARING AND SNAGGING PLAN

COW CASTLE CREEK

ORANGEBURG COUNTY, SOUTH CAROLINA

(i = 7 7/8%)

Annual Project Cost - Construction

Federal	$10,700
Non-Federal	2,000
SUBTOTAL	$12,700

Annual Project Maintenance

Non-Federal	$ 4,300

Total Annual Cost

Federal	$10,700
Non-Federal	6,300
TOTAL	$17,000

Annual Project Benefits

Damage Reduction	$22,350
Agricultural	500
TOTAL	$22,850

Benefit-to-Cost Ratio

Total Project	1.34 to 1

BENEFIT-TO-COST ANALYSIS

Table 8 summarizes the benefit-to-cost analysis expected from implementation of the clearing and snagging plan. Project cost have been summarized previously in Table 6 and resulting benefits have been presented in Table 7. Comparison of project cost to benefits results in a benefit-to-cost ratio of 1.34 to 1 as shown in Table 8.

Plan Implementation

INSTITUTIONAL REQUIREMENTS

The selected plan can be implemented efficiently by existing governmental agencies. A formal agreement will be entered into as required by Section 221 of the River and Harbor Act of 31 December 1970 (Public Law 91-611). Orangeburg County will serve as the local sponsor and is a legally constituted public body with full authority and capability to perform the terms of its agreement and to pay damages, if necessary, in the event of failure to perform (P.L. 91-611, Section 221(b)).

DIVISION OF PLAN RESPONSIBILITIES

In general the Federal Government will prepare construction plans, contract for the execution of planned work, and will pay the cost of contracted work. However, since the required work in Even Branch is outside the Federal jurisdictional authority, the total first cost of that portion must be borne by the local sponsor. Work on Even Branch will be required as part of the total project. This work may be included as part of the

Federally administered contract provided the local sponsor contributes the funds to cover cost of work on Even Branch, or the local sponsor may perform the work with their personnel or by separate contract. The sponsor will also be required to acquire real estate and arrange or perform relocations as needed. In addition to this, the sponsor will be responsible for maintenance of the project over its economic life and to prevent unwise use of the flood plan. The a, b, c's of sponsorship are spelled out in the Recommendations Section which follows. Approximate cost sharing giving in Table 6 estimates the Federal first cost at $132,000 and the non-Federal first cost at $26,000. The annual cost of maintenance for the county would be about $4,300.

VIEWS OF NON-FEDERAL SPONSOR

In the conduct of the study, Orangeburg County Council has participated in the formulation, assessment, and selection of a plan and are in agreement with the recommendation. A letter of intent to sponsor the project has been received from Orangeburg County and is included in Appendix D.

Summary Of Coordination, Public Views and Comments

There were no public meetings held in the conduct of this study. The study team did, however, correspond and meet with Federal, state, and county agencies and with individuals and special interest groups. Information gathered in this manner revealed a preference for a solution that would not cut into real estate holdings and one that would preserve the natural aesthetics and environmental quality of the area.

The U. S. Fish And Wildlife Service Coordination Report is included in Appendix D.

ENVIRONMENTAL CONSIDERATIONS

The following pages present an Environmental Assessment analyzing the impacts resulting from implementation of the proposed clearing and snagging plan on Cow Castle Creek and Even Branch. This section is followed by a Findings of No Significant Impact (FONSI). These documents satisfy requirements of pertinent environmental legislation required prior to implementation of a Federal project.

Recommendations

Based on the findings of this report, it is recommended that a Federal project be authorized under authority of Section 208 of the 1954 Flood Control Act, as amended, and as described in this report, with such modifications as in the discretion of the Chief of Engineers may be deemed advisable. The project would consist of clearing and snagging of Cow Castle Creek for a distance of 1.5 miles and clearing of Even Branch for a distance of 1.7 miles at an estimated Federal construction cost of $132,000 provided that local interests:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including suitable disposal areas as determined by the Chief of Engineers, necessary for project construction. The acquisition of all lands or interests in lands necessary for the project shall be accomplished in accordance with Public Law 91-646, Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

b. Provide necessary improvements or the cost thereof for that portion of the recommended project in areas which do not qualify for Federal assistance (Even Branch) but are necessary for full realization of project benefits.

c. Provide all government costs which exceed the statutory limitations of government participation.

d. Hold and save the United States free from damages due to construction, operation, and maintenance of the project, provided damages are not due to the fault or negligence of the United States or its contractors.

e. Maintain and operate the works after completion in accordance with regulations prescribed by the Secretary of the Army.

f. Prescribe and enforce regulations to prevent obstruction or encroachment on channels or other flood control works which would reduce their flood carrying capacity or hinder maintenance and operation.

g. At least annually, inform affected areas that the channel improvement will not provide complete flood protection.

h. Publicize flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project.

F. E. SMITH, JR.
LTC, Corps of Engineers
District Engineer

15 July 1983

ENVIRONMENTAL ASSESSMENT

FOR

COW CASTLE CREEK FLOOD CONTROL PROJECT

IN

BOWMAN, ORANGEBURG COUNTY, SOUTH CAROLINA

THE ENVIRONMENTAL ASSESSMENT OF THE PROPOSED ACTION

PROPOSED ACTION

Need for the project. On 7 April 1981 Orangeburg County requested federal assistance in the identification and construction of a cost effective flood control project on Cow Castle Creek in the vicinity of Bowman, South Carolina. A reconnaissance study was conducted resulting in a finding that the flooding problem was severe enough to justify a detailed study of measures to reduce the flood damage.

Several solutions to the flooding problem were studied and a reconnaissance report was prepared in May 1982. The recommendation of the reconnaissance study was that clearing and snagging improvements to a 1½ mile reach of the creek would be the best flood control measure as well as the most cost effective.

Project Description. The recommended plan consists of clearing and snagging of the existing channel for a total length of approximately 8,000 feet. Work would extend from a point about 3/4 miles upstream of South Carolina Highway 210 to a point approximately 3/4 miles downstream of S. C. Highway 210. In addition to this clearing and snagging of the main channel of Cow Castle Creek, and to provide maximum project benefits, the Even Branch tributary which passes through the Town of Bowman would be cleaned to reestablish a natural flow. The work in Even Branch would be the responsibility of the local sponsor. All work would be limited in scope in order to assure the preservation of scenic qualities along the banks, while still addressing the objectives of increased channel effeciency. Total land requirement for the selected plan is approximately 37 acres. This is based on the acquisition of a 200-foot cleared width for a distance of approximately 8,000 feet.

All clearing would take place on the northeast side of the creek (see Figure 1). Snags, drift, and other debris would be removed from the creek

channel. Small trees and all brush would be removed from the entire cleared width. All trees 12 inches or greater in diameter would be left undisturbed. The work in Even Branch would be limited to clearing of the debris between the existing banks and at culvert ends to establish free flow. As clearing and snagging work is completed, the cleared area would be planted with various seed plants such as annual lespedeza, brown top millet, bahiagrass, or common Bermuda grass to prevent bank erosion and to enhance the wildlife habitat values.

ENVIRONMENTAL SETTING WITHOUT THE PROJECT

General Description of the Area. Cow Castle Creek is located in the central part of Orangeburg County. The stream flows in a southeastward direction roughly parallel to U. S. Highway 178, from its headwaters in the City of Orangeburg to the vicinity of the Town of Bowman. From this point, the stream curves gently eastward to its confluence with Four Hole Swamp about midway between the Towns of Bowman and Holly Hill. The creek nearly parallels U. S. Highway 178 upstream of Bowman and S. C. Route 210 downstream of town. Distances of the creek from the highway vary from a few hundred feet to about one mile south of S. C. Highway 210. Streams tributary to Cow Castle Creek include Crum Branch, Sandy Creek, Buck Branch, Partick Branch, and several smaller tributaries. Interstate Highway 26 crosses Cow Castle Creek about 1½ miles above its confluence with Four Hole Swamp. The creek also is crossed by S. C. Highway 210 near the eastern city limit of Bowman, S. C. and by numerous secondary roads throughout its length.

Land Use. Two principle highways pass through the City of Bowman. These are U. S. Highway 178 and S. C. Highway 210. The main commercial street of

Bowman (U. S. Highway 178) is constructed along a ridge. Residences and some commercial structures are located on each side of this ridge which runs in a northwest-southeast direction. S. C. Highway 210 crosses the southern part of Bowman approximately perpendicular to U. S. Highway 178. The total estimated acreage within the City of Bowman is about 660 acres, most of which is developed. The undeveloped acreage includes small farms, woodlands, and drainage features.

Topography. Topography of the basin is typical of the coastal plain region, being relatively flat, with surface elevations ranging between 100 and 200 feet NGVD.

Climate. The study area has mild winters and hot summers. Temperatures drop below freezing on about 45 days per year, but rarely drop to 0° Fahrenheit. Temperatures reach 90° Fahrenheit on about 80 days per year. The area receives about 47 inches of precipitation per year.

Water Quality. Cow Castle Creek lies within the Edisto River drainage basin. The Edisto Basin is located in the south central portion of South Carolina, and is bordered by the Combahee River basin on the west and the Cooper and Congaree River basin, as well as Lakes Moultrie and Marion on the east. The head waters of the basin are located near the fall line which divides the coastal plain and Piedmont plateau. The river empties into the Atlantic Ocean. Four Hole Swamp is a tributary to the Edisto and Cow Castle is a tributary to Four Hole Swamp. Water quality in Cow Castle Creek is considered good as it is classified B by the South Carolina Department of Health and Environmental Control. Class B freshwaters are suitable for secondary contact recreation and as a source for drinking water after conventional treatment. Class B waters are also suitable for fishing, survival, and propagation of fish. It is also considered suitable for industrial and agricultural uses.

Flora. Vegetation occurring within the study area is typical of southern coastal plain flora. The Cow Castle Creek basin is largely comprised of pine and pine-mixed hardwood forest lands and wetlands. Some of the higher basin is currently being farmed. In the lower reaches of the Cow Castle basin, the flood plain widens considerable and consists primarily of palustrine forested wetlands. The two major forested wetland communities

that occur in the basin are mixed bottomland hardwoods and bald cypress-water tupelo. Overstory species include sweetgum, blackgum, bald cypress, yellow poplar, sycamore, water oak, willow oak, loblolly pine and longleaf pine. Understory and ground cover species include dogwood, privet, honeysuckle, poison ivy, Virginia creeper, rushes, and plantains. The predominant aquatic species within Cow Castle Creek are duckweed and alligator weed. Smartweed is prominent around the various bridge abutments at the creek crossings.

Wildlife. The wetlands and upland habitat types of the Cow Castle Creek basin provide the diversity of vegetative communities to support a wide variety of wildlife species. Feeding, reproductive, and cover habitat are provided for game and fur-bearing species, as well as non-game species of mammals, birds, fish, reptiles, and amphibians.

Mammals - Herbivores in the project area include mammals ranging from small rodents to the white-tail deer. Some less conspicuous herbivorous mammals that occur in the flood plain ecosystem are the white-footed mouse, hispid cotton rat, eastern harvest mouse, and pine vole. Several species of nut and acorn bearing trees would furnish food and nesting areas for the grey squirrel, the flying squirrel, and the fox squirrel. Other fairly common omnivorous animals that would typically use the study area are the raccoon, opossum, and feral hog. Carnivorious mammals in the project area range in size from the least shrew to the bobcat.

Birds - The vegetation in the project area provides a good interspersion of low, medium, and upper canopy habitat that fulfills the feeding and nesting needs of a variety of song birds. There are occasional fields located adjacent to or in the upper flood plain. These fields support rodents which are food for several species of hawks and owls. The banks of Cow Castle Creek are lined with thickets which provide good habitat for the woodcock. There are also adequate amounts of brood habitat and den trees along the creek for wood ducks.

Reptiles - The diverse habitat conditions in the project area furnish the life requirements of a number of reptiles. Some of the more common ones expected to occur are the snapping turtle, eastern mud turtle, five lined skink, eastern garter snake, eastern ribbon snake, cotton-mouth water moccasin, rat snake, copperhead, and timber rattlesnake.

Fish. Currently, the 1.5 mile stretch of creek provides fair to good fishery habitat. The creek is very shallow in places with occasional holes or deeper sections at log obstructions and other restrictions. A fishery survey taken in 1978 showed the following fish inhabiting Cow Castle Creek: largemouth bass, readbreast, dollar sunfish, warmouth, spotted sunfish, shellcracker, mud sunfish, bluegill, creek chubsucker, redfin pickerel, pirate perch, gambusia, tessellated darter, dusky shiner, iron color shiner, coastal shiner, speckled madtom, and tadpole madtom.

Threatened and Endangered Species. There is no critical habitat for any endangered or threatened species, nor is there any potential for adversely affecting any endangered or threatened species within the study area.

Cultural Resources. A cultural resources reconnaissance indicated no significant cultural resources within the project area.

Socio-Economics. Population, housing, historical trends, projected population, employment, income, etc. of the present area are discussed in detail in the main report. Detailed information pertaining to the economic analysis of the recommended plan is contained in Appendix B of this report.

PROBABLE IMPACTS OF THE PROPOSED ACTION

The proposed action would consist of approximately 1.5 miles of clearing and snagging work. These stream and stream-bank improvements will reduce projected annual flood damages to existing development by approximately 69%.

Land Disruption. Approximately 37 acres of typical southern coastal flood plain would be cleared of all underbrush and trees up to 12 inches in diameter. Large trees are to remain. Snags, drift, and other debris would be removed from the creek and burned along with the underbrush. The only disruption expected to occur as a result of this plan would be minor land scars caused by equipment when piling up underbrush for burning. This entire cleared area would be planted with seed-bearing plants upon completion.

Noise. During the clearing and snagging phase of this plan, there would be an increase in the ambient noise level, but it is anticipated that this increase in the ambient noise level would not be significant.

Water Quality. Would not be significantly impacted.

Air Quality. Any increase in air pollution would occur during the clearing and snagging phase as a result of exhaust fumes from equipment and smoke

from the burning of underbrush, etc. The increase would be minor, temporary, and in compliance with city ordinances.

Historic and Archaeological Resources. There are no historic or archaeological resources in the immediate area of the proposed project. The project will not have any impact on any property in or listed as eligible in the National Register of Historic Places. An historic and archaelogical reconnaissance report is included as Appendix E of the main report.

Wildlife. The area impacted by this plan is a 200-foot wide strip extending along the southern side of Cow Castle Creek for approximately 1.5 miles. This strip would be cleared of underbrush and small trees causing the wildlife use patterns to change. Some wildlife species which currently use this area for nesting and cover would be displaced to adjoining areas with like habitat. Other species would be attracted to the area after clearing and seeding. It is expected that a cleared park-like habitat along the creek would enhance the over-all value of the immediate project site by introducing some variety to the otherwise densely wooded area.

Fishery. Cow Castle Creek is a tributary to Four Hole Swamp. The head waters are approximately 20 miles upstream in the vicinity of Orangeburg, South Carolina. Fishery resouces in Cow Castle Creek are considered fair to good for its entire length with the better habitat in the lower reaches of the creek. Clearing and snagging debris, logs, etc. from a 1½ mile streatch of the creek at Bowman, will cause some temporary turbidity as well as the destruction of some fish spawning and nursery habitat. Given the length of this creek and the scope of the proposed project, both the temporary turbidity impact and the removal of spawning and nursery habitat is not believed to be significant to fishery resources in Cow Castle Creek.

Socio-Economics. Construction of this project would cause no significant change in the social structure or economic base of the project area.

Endangered species. This flood control project would not jeopardize the continued existence of any threatened or endangered species. There is no critical habitat within the area of project influence.

Unavoidable Adverse Impacts

Adverse environmental effects associated with this project are as follows:

There would be a temporary increase in noise and air pollution during the construction phase of the project.

There would be a temporary increase in siltation and turbidity during the construction stage.

There would be a small loss of fishery spawning and nursery habitat as a result of debris removal.

Approximately 37 acres of understory and groundcover vegetation would be cleared resulting in a change in wildlife use.

Alternatives to the Proposed Action

Several alternative measures to meet the problems and needs of the area are possible; however, some of these measures are not practical or economical. Possible solutions may be divided into two categories of structural and non-structural. Structural measures are designed to modify floods by altering the natural environment. These measures include alternatives which reduce flood elevations, divert floods, change the timing and duration of floods, or restrict floods from portions of the flood plain. Non-structural measures are designed to modify flood damage susceptibility and include modifications to the cultural environment by adjustment in the pattern and mode of land use, by development policies, and by assistance to affected individuals. Also, a combination of structural and non-structural measures is possible. Structural, non-structural, combined, and no-action alternatives are discussed in the main report.

Maintenance

After Cow Castle Creek is cleared, snagged, and the cleared bank replanted in seed bearing herbaceous plants, maintenance of the bank will become the responsibility of the local sponsor. Any one of several methods could be used by the sponsor to maintain the bank, but because maintenance of the project involves the nurturing of seed bearing herbaceous plants while eliminating woody shrubs, the recommended method is seasonal applications of a herbicide. An EPA certified herbicide known as 2, 4-D would satisfy the management requirements of this project and is considered cost effective when compared with other methods. Environmental impacts of using 2, 4-D when applied by a certified applicator would not be significantly greater than the impacts associated with the initial clearing of the stream bank which is addressed in other sections of this assessment.

Conclusions

The proposed action does not constitute a major Federal action significantly affecting the quality of the human environment, therefore, the preparation of an Environmental Impact Statement (EIS) provided for under Section 102(c) of the National Environmental Policy Act of 1969 is not required.

Coordination

The draft report, including the Environmental Assessment, was circulated for public review on 1 June 1983. Letters of comment were received only from the U. S. Fish and Wildlife Service, the Environmental Protection Agency, the National Marine Fisheries Service, and the Soil Conservation Service. These letters do not necessitate any change in the report and do not require a response.

FINDING OF NO SIGNIFICANT IMPACT
COW CASTLE CREEK FLOOD CONTROL PROJECT
IN
BOWMAN, ORANGEBURG COUNTY, SOUTH CAROLINA

Based upon the attached Environmental Assessment and in consideration of other pertinent documents, I conclude that the environmental effects of the proposed Cow Castle Creek Flood Control Project are not significant and the preparation of an Environmental Impact Statement is not warranted. Specific factors considered in making the determination include the following:

1. Best available practices would be used to clear underbrush and small trees from the proposed floodway.

2. Best available practices would be used to remove logs, debris, etc. from the creek.

3. Planting of the cleared floodway with seed-bearing plants would use best available practices to not only reduce erosion but to provide wildlife enhancement.

4. Wetlands would not be significantly affected.

5. No significant cultural resource would be affected.

6. No endangered species would be affected.

7. No significant land use changes would occur.

8. Air quality would not be significantly affected.

9. Flood plain values would not be significantly affected.

10. Fish and wildlife would not be significantly affected.

11. Construction activities would be short term and would not significantly affect navigation or recreational boating.

F. L. SMITH, JR.
LTC, Corps of Engineers
Commanding

15 July 1983

APPENDIXES

US Army Corps
of Engineers
Charleston District

COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA

DETAILED PROJECT REPORT

COW CASTLE CREEK

ORANGEBURG COUNTY, SOUTH CAROLINA

DETAILED PROJECT REPORT

LIST OF APPENDIXES

APPENDIX	TITLE
A	HYDROLOGIC AND HYDRAULIC EVALUATION
B	ECONOMICS OF ALTERNATIVE PLAN
C	CONSTRUCTION PLANS AND MAINTENANCE PROGRAM
D	PERTINENT CORRESPONDENCE
E	CULTURAL RESOURCES STUDY

US Army Corps
of Engineers
Charleston District

APPENDIX A

COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA

HYDROLOGIC AND HYDRAULIC EVALUATIONS

APPENDIX A

HYDROLOGIC AND HYDRAULIC EVALUATIONS

TABLE OF CONTENTS

LIST OF TABLES

APPENDIX A
HYDROLOGIC AND HYDRAULIC EVALUATIONS

GENERAL

1. Cow Castle Creek is located in Orangeburg County, South Carolina with its headwaters in the City of Orangeburg. The stream flows by the outskirts of the Town of Bowman and drains into Four Hole Swamp. The drainage area for Cow Castle Creek at the mouth is 57.5 square miles. Figure A-1 is a basin map for Cow Castle Creek.

2. The proposed Cow Castle Creek project consists of selective clearing and removal of vegetation and debris along an 8,000-foot reach from 4000 feet below S. C. Highway 210 to just downstream of the S. C. Highway 36 bridge. The clearing will be for a width of 200 feet along the left bank, including the channel looking downstream. This work will result in an increase in the hydraulic efficiency of the channel and its overbanks, primarily through the reduction of roughness or friction losses. A description of the hydrologic and hydraulic analysis performed for Cow Castle Creek is given in the following paragraphs.

HYDROLOGY

3. USGS Stream Gage Station No. 0217425 has been in operation on Cow Castle Creek just above Bowman, South Carolina, Since October 1970. The annual peak discharges recorded at this gage are shown in Table A-1. The discharge-frequency curve for the gage, Figure A-2, was determined by utilizing this data and the Hydrologic Engineering Center's computer program entitled "Flood Flow Frequency Analysis." This program conforms to

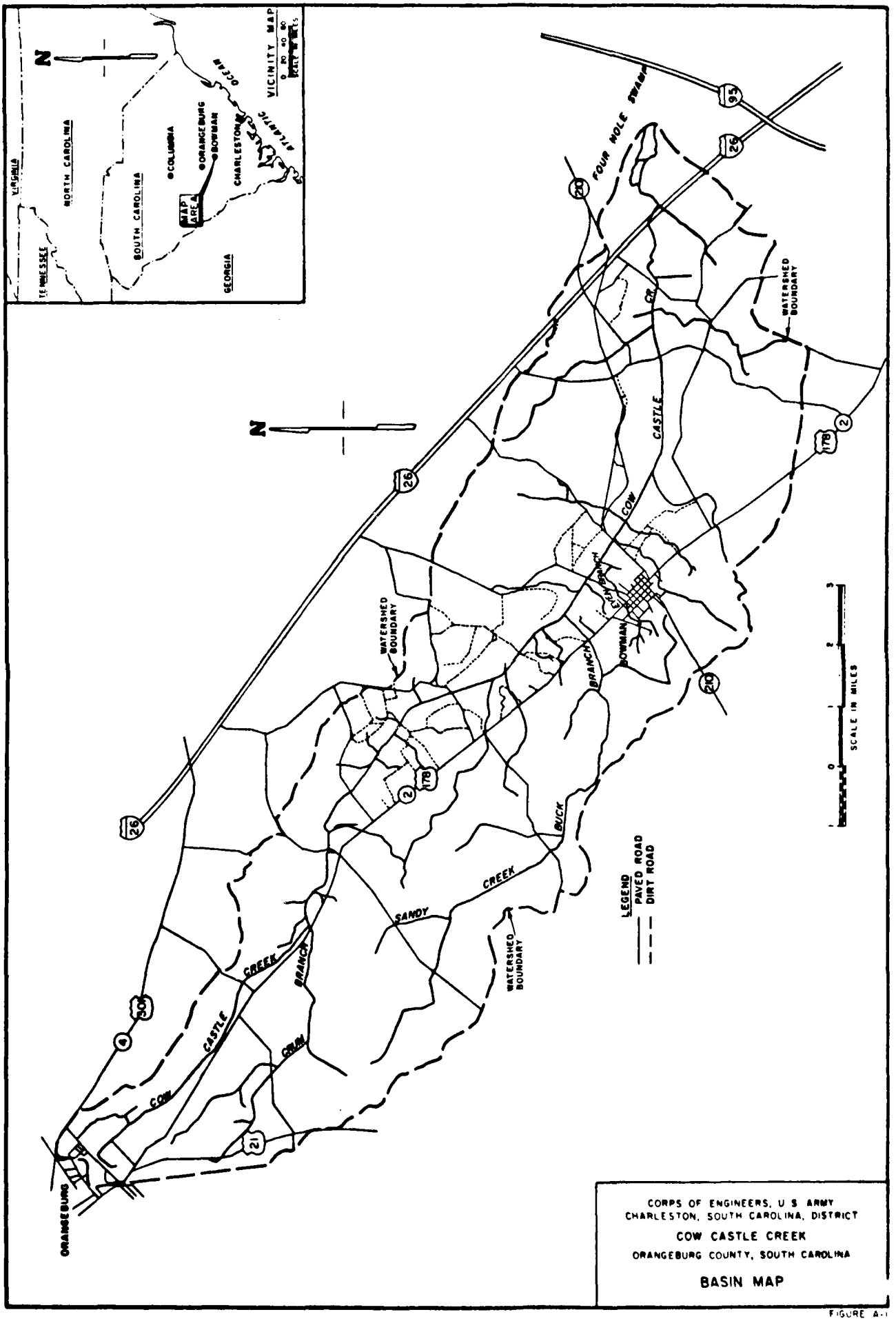

VICINITY MAP
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
TENNESSEE
VIRGINIA
COLUMBIA
ORANGEBURG
BOWMAN
CHARLESTON
ATLANTIC OCEAN
MAP AREA
N
FOUR HOLE SWAMP
COW CASTLE CREEK
WATERSHED BOUNDARY
BOWMAN
BRANCH
BUCK CREEK
SANDY CREEK
COW CASTLE CREEK
COW CREEK BRANCH
ORANGEBURG
SCALE IN MILES
LEGEND
PAVED ROAD
DIRT ROAD
CORPS OF ENGINEERS, U S ARMY
CHARLESTON, SOUTH CAROLINA, DISTRICT
COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA
BASIN MAP

FIGURE A-1

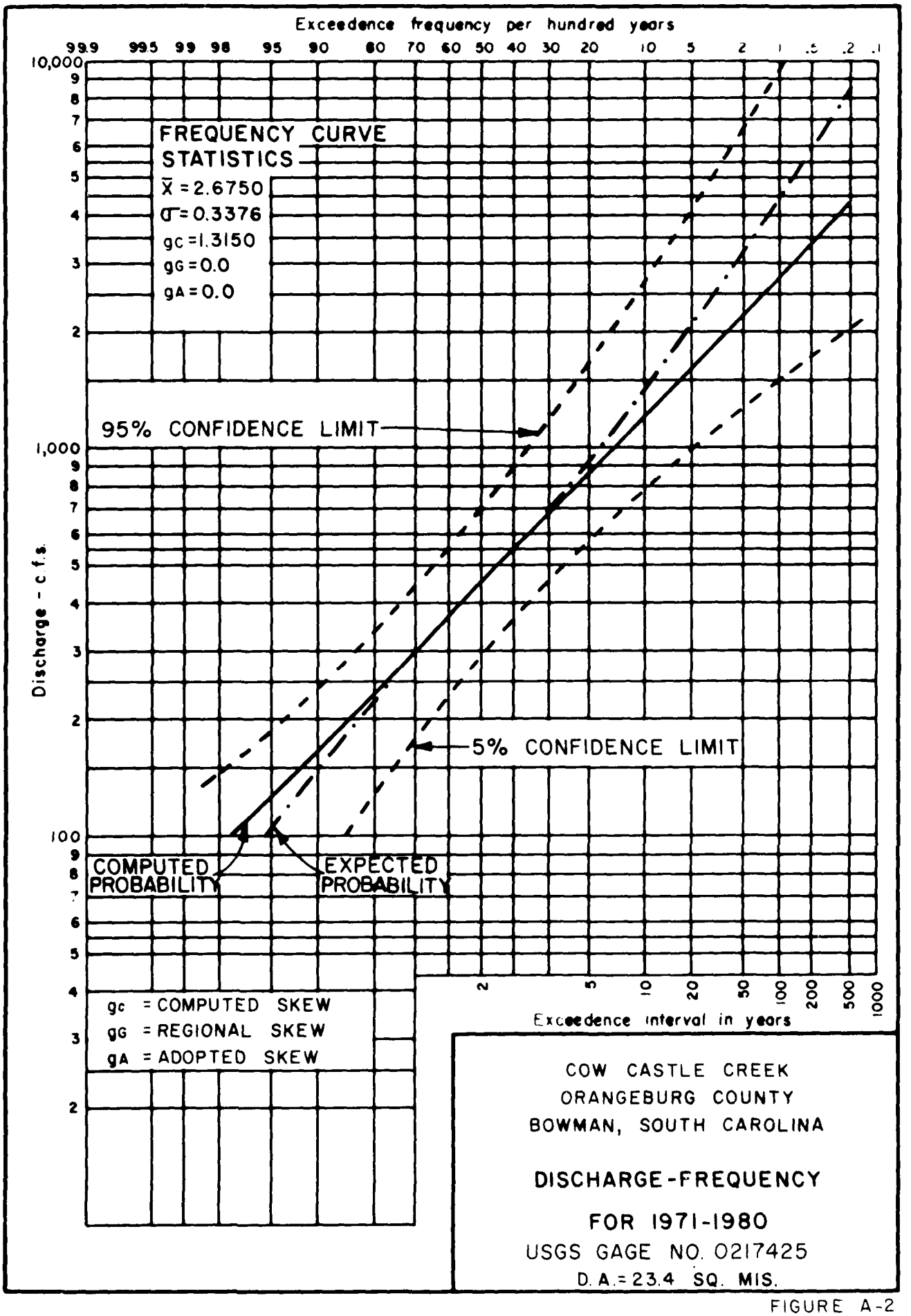

Exceedence frequency per hundred years
99.9 99.5 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 .5 .2 .1
10,000
1,000
100
Discharge - c.f.s.
FREQUENCY CURVE STATISTICS
X̄ = 2.6750
σ = 0.3376
gc = 1.3150
gG = 0.0
gA = 0.0
95% CONFIDENCE LIMIT
5% CONFIDENCE LIMIT
COMPUTED PROBABILITY
EXPECTED PROBABILITY
gc = COMPUTED SKEW
gG = REGIONAL SKEW
gA = ADOPTED SKEW
2 5 10 20 50 100 200 500 1000
Exceedence interval in years
COW CASTLE CREEK
ORANGEBURG COUNTY
BOWMAN, SOUTH CAROLINA
DISCHARGE-FREQUENCY
FOR 1971-1980
USGS GAGE NO. 0217425
D.A. = 23.4 SQ. MIS.

FIGURE A-2

the methods and procedures presented by the United States Water Resources Council in Bulletin 17B entitled, "Guidelines for Determining Flood Flow Frequency" dated September 1981. Expected probability discharges were used for this study.

TABLE A-1

COW CASTLE CREEK NEAR BOWMAN, SOUTH CAROLINA
ANNUAL PEAKS (USGS GAGE #0217425)
(Drainage Area = 23.4 Square Miles)

Year	Discharge (cfs)	Year	Discharge (cfs)
1971	466	1976	292
1972	188	1977	306
1973	1290	1978	406
1974	278	1979	2340
1975	267	1980	493

4. Discharge-frequency relationships were also derived at the confluence of Even Branch, and at the mouth of Cow Castle Creek. The discharge-frequency relationship for the gage was adjusted for drainage area and used at other locations along the creek. The Standard Project Flood was assumed to be equivalent to the 500-year event. Table A-2 lists the adopted discharges at the selected locations and return frequencies.

TABLE A-2

ADOPTED DISCHARGE-FREQUENCY DATA AT VARIOUS LOCATIONS

Locations	Drainage Area (Sq Mi)	Recurrence Interval in Years 2	10	25	50	100	500 (SPF)
Cow Castle Creek at Mouth	57.50	710	2200	3560	5030	7100	12800
Cow Castle Creek At Even Branch	33.90	550	1690	2740	3860	5450	9850
Cow Castle Creek at USGS Gage	23.40	450	1400	2270	3210	4530	8180
Even Branch	2.38	-	476	-	710	809	1051

5. The hydrologic analysis for Even Branch, a tributary to Cow Castle Creek, was performed by Wilbur Smith and Associates under contract for the Federal Insurance Administration. Results of their work were published in a Flood Insurance Study report for the town of Bowman, South Carolina, dated January 1980. The discharge-frequency relationship for the mouth of Even Branch was used in this analysis and is shown in Table A-2.

HYDRAULICS

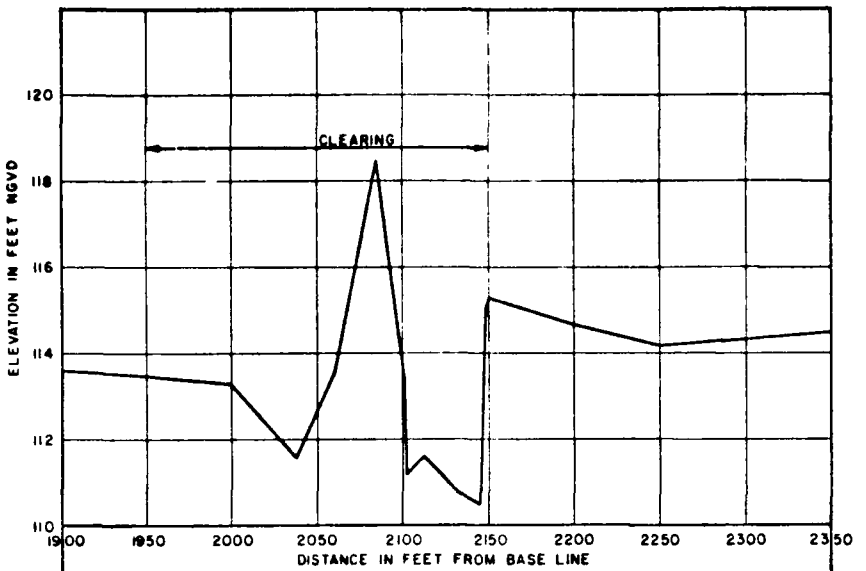
6. All water surface profiles were computed using the Hydrologic Engineering Center's HEC-2 Computer Program, "Water Surface Profiles." Profiles for both existing and improved conditions were computed for floods having recurrence intervals of 2-, 10-, 25-, 50-, 100-, and 500-years. Nine cross sections and all bridges in the study reach of Cow Castle Creek were surveyed. Manning's "N"

values for the existing stream channel ranged from 0.065 to 0.100 with overbank "N" values of 0.180.

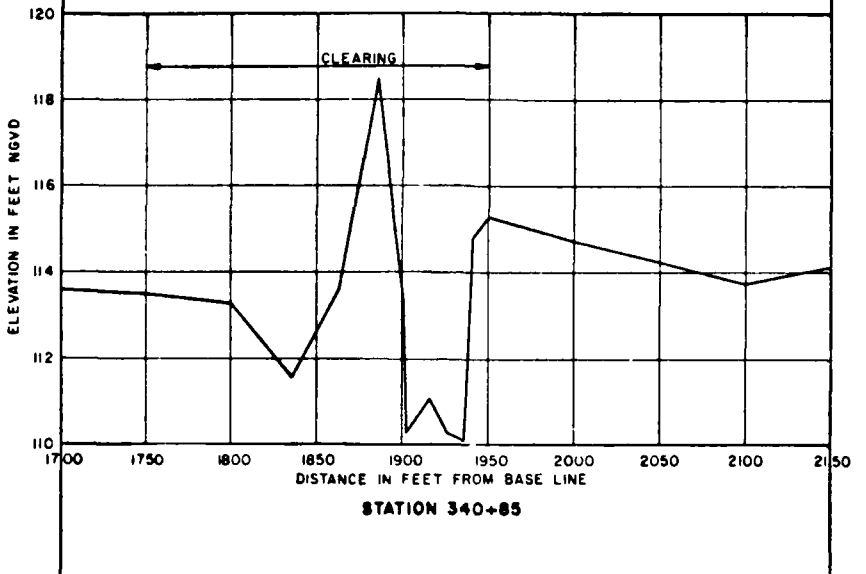
7. Water surface profile computations were started at the mouth of Cow Castle Creek and its confluence with Four Hole Swamp. The starting water surface elevations for Cow Castle Creek were obtained after examining conditions at Four Hole Swamp. Water surface profiles of Cow Castle Creek in the vicinity of Bowman were not sensitive to starting water surface elevations at the mouth of Cow Castle Creek.

8. Reduction of a channel's "N" value results in an increase in the channel discharge capacity at a specified stage and thus reduces the flood levels for various frequency floods. The flood plain of Cow Castle Creek is forested and has minimal topographic relief. A long reach of the channel had been improved in 1944. The disposal from this improvement was piled on both sides of the channel. These disposal mounds are evident on the cross sections shown on Figures A-3 and A-4. The main channel is narrow and shallow, so that floodwaters, including the 2-year event, overflow its banks. The proposed project will permit greater flows within the 200-foot area of cleared overbank and channel. This situation results in a greater flood stage reduction of larger flood events.

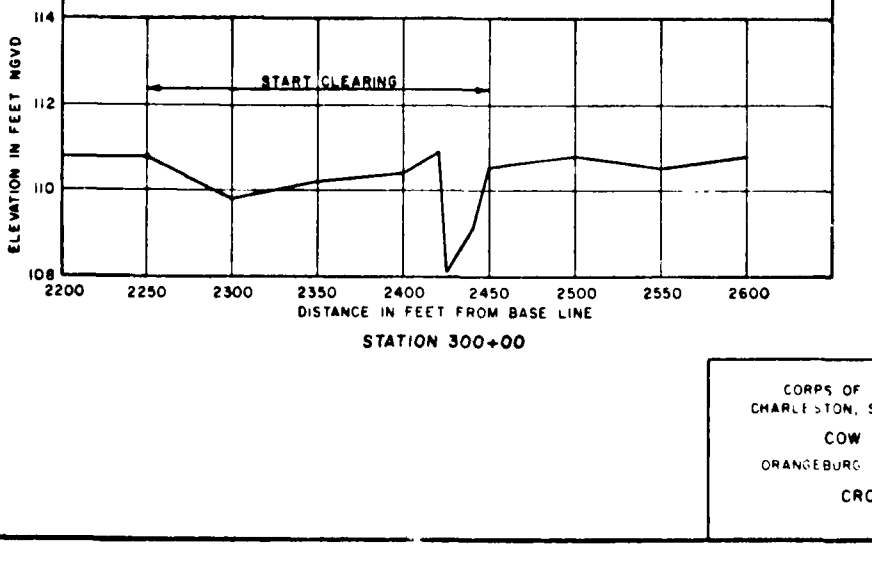
9. An "N" value of 0.045 was selected for the cleared area within the improved reaches of the proposed project. This decrease in the roughness coefficient resulted in an approximate stage reduction of 0.7 and 1.0 feet for the 10-year and 100-year floods respectively. Average channel velocities for the 10-year frequency flood are less than 2 feet per second for the existing and improved conditions. A discharge rating curve for existing and improved conditions is shown on Figure A-5. Existing condition profiles for the 2-, 10-, 25-, 50-, 100-, and 500-year floods are shown on Figure A-6 and A-7. Improved condition profiles for the 2-, 10-, 25-, 50-, 100-, and 500-year floods are shown on Figure A-8. Existing and improved condition profiles for the 10-, 100-, and 500-year events are shown on Figure A-9.



STATION 341+85



STATION 340+85



STATION 300+00

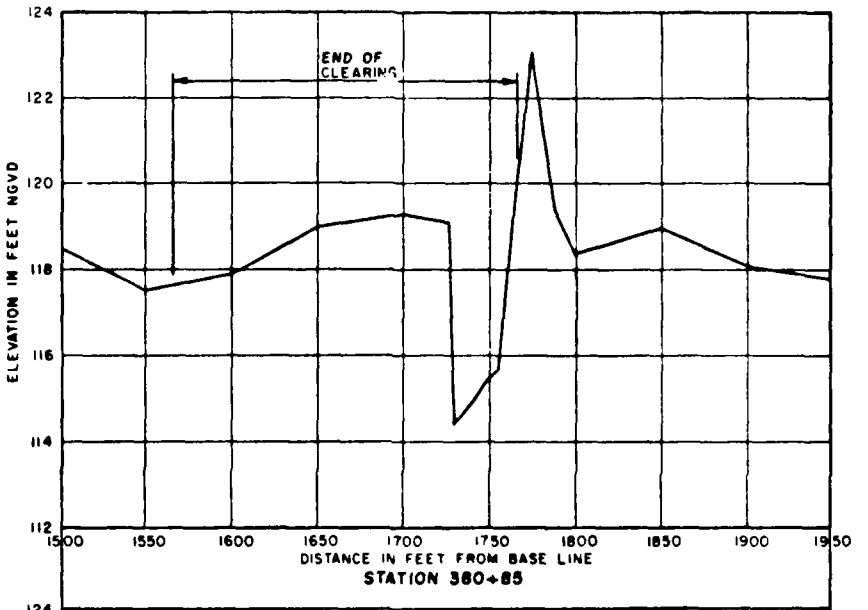
CORPS OF ENGINEERS, U S ARMY
CHARLESTON, SOUTH CAROLINA, DISTRICT

COW CASTLE CREEK

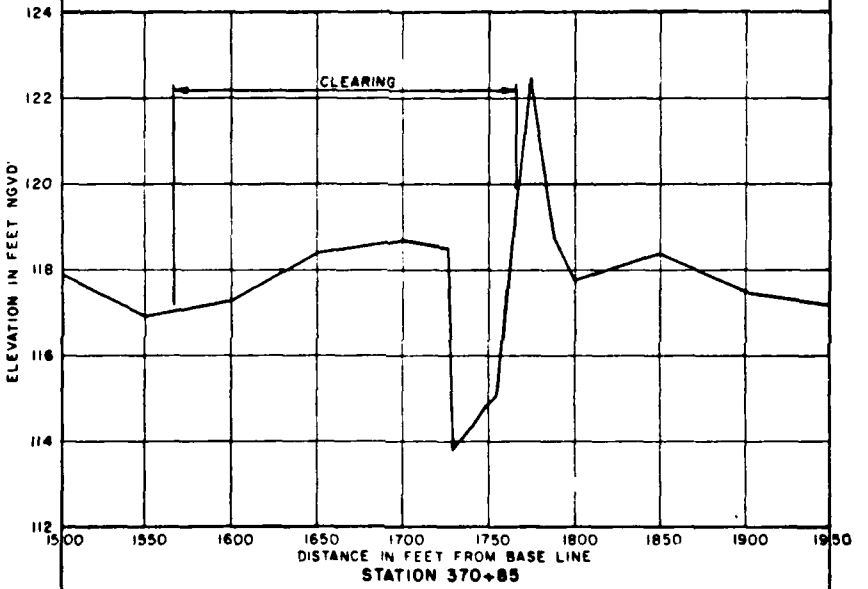
ORANGEBURG COUNTY, SOUTH CAROLINA

CROSS SECTIONS

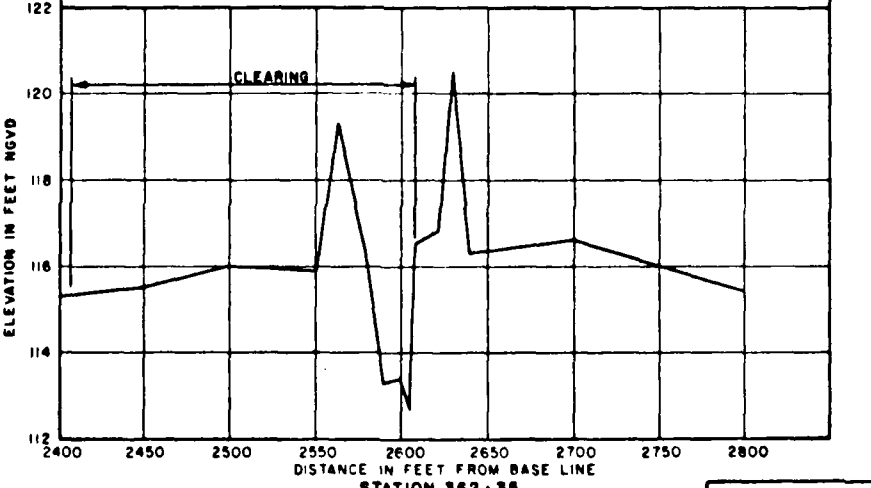
FIGURE A-3



STATION 360+85



STATION 370+85



STATION 362+35

CORPS OF ENGINEERS, U S ARMY
CHARLESTON, SOUTH CAROLINA, DISTRICT

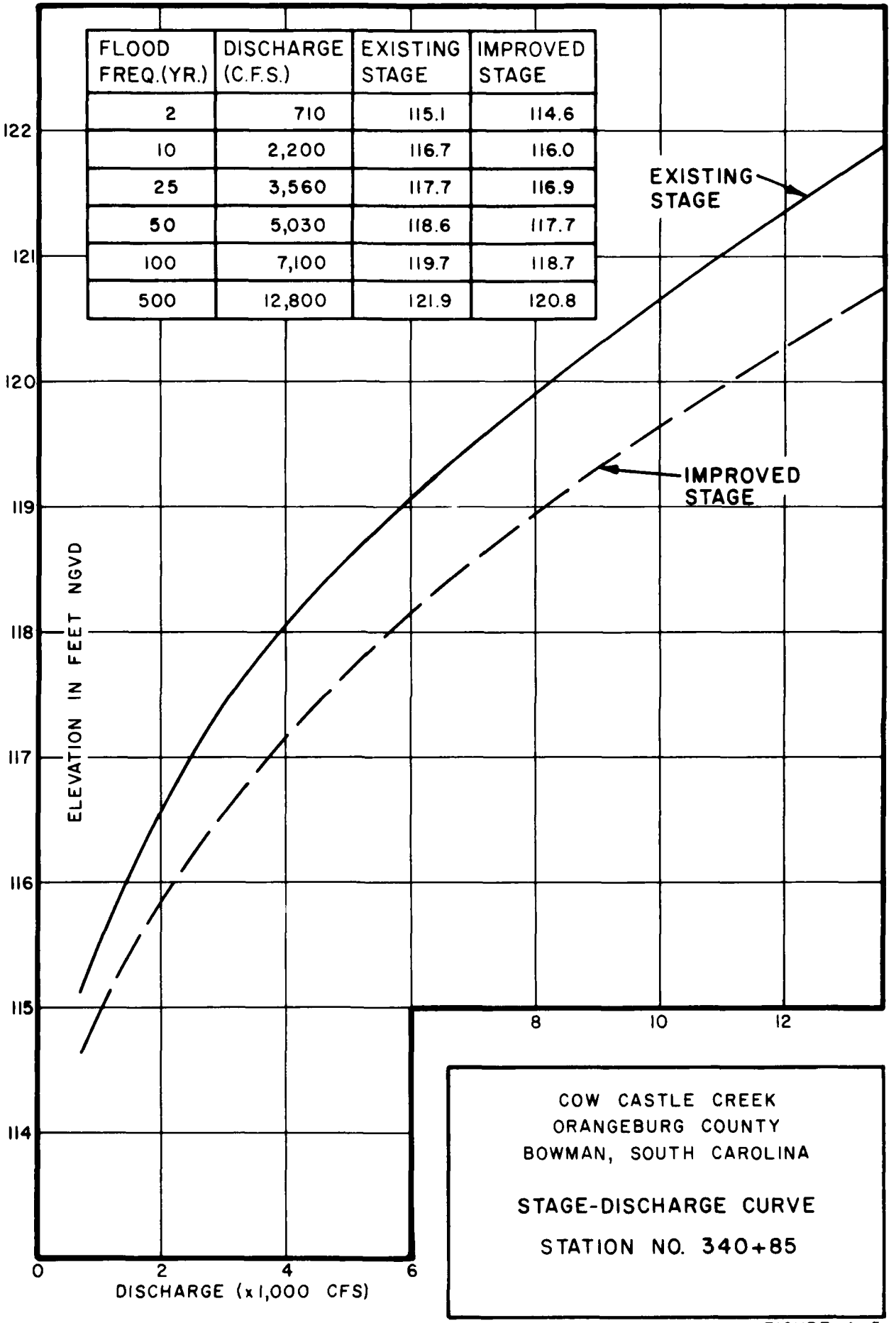
COW CASTLE CREEK

ORANGEBURG COUNTY, SOUTH CAROLINA

CROSS SECTIONS

FIGURE A-4

FLOOD FREQ.(YR.)	DISCHARGE (C.F.S.)	EXISTING STAGE	IMPROVED STAGE
2	710	115.1	114.6
10	2,200	116.7	116.0
25	3,560	117.7	116.9
50	5,030	118.6	117.7
100	7,100	119.7	118.7
500	12,800	121.9	120.8



COW CASTLE CREEK
ORANGEBURG COUNTY
BOWMAN, SOUTH CAROLINA

STAGE-DISCHARGE CURVE

STATION NO. 340+85

FIGURE A-5

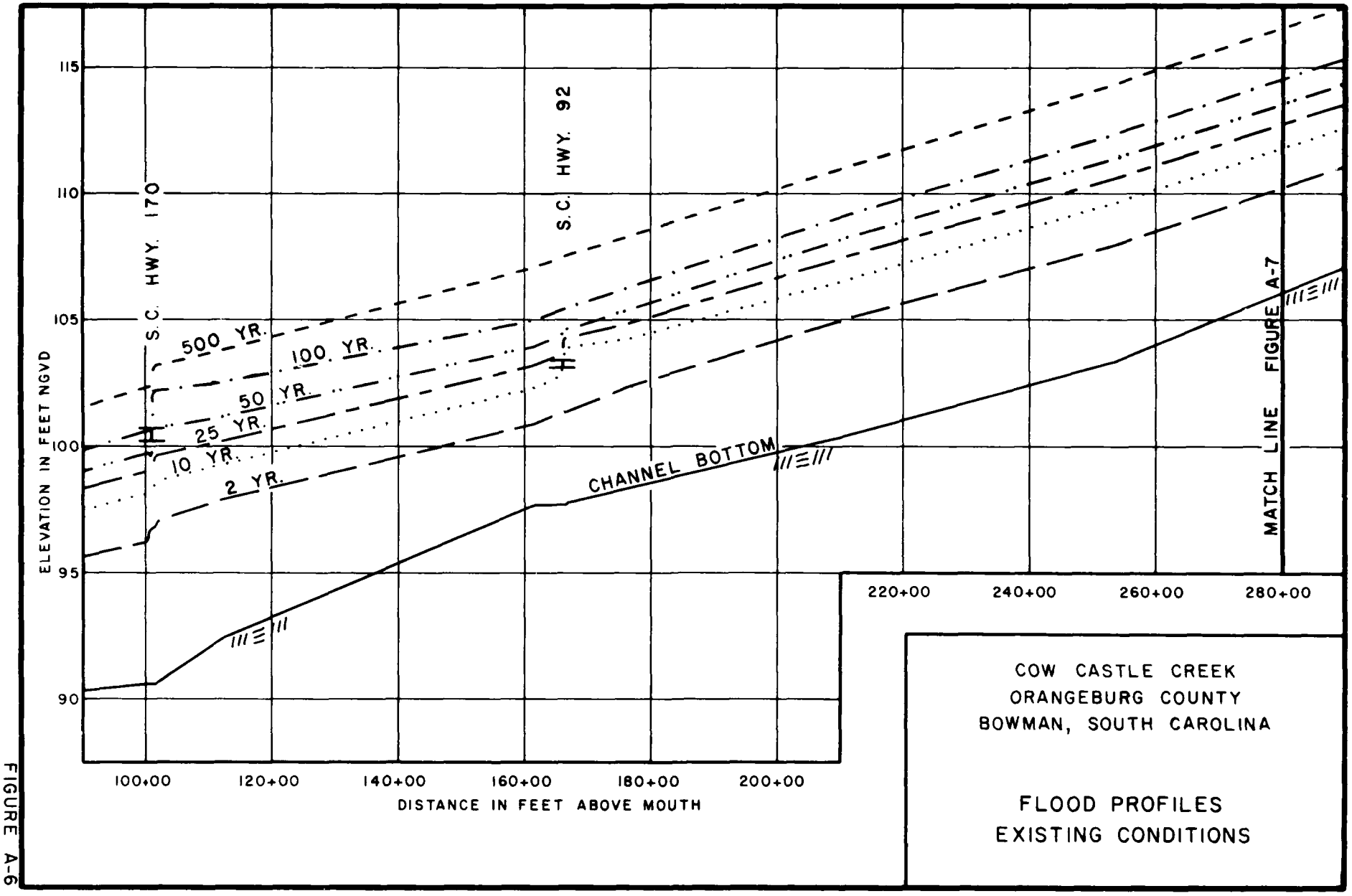

ELEVATION IN FEET NGVD
115
110
105
100
95
90
S.C. HWY. 170
S.C. HWY. 92
500 YR.
100 YR.
50 YR.
25 YR.
10 YR.
2 YR.
CHANNEL BOTTOM
MATCH LINE FIGURE A-7
100+00
120+00
140+00
160+00
180+00
200+00
220+00
240+00
260+00
280+00
DISTANCE IN FEET ABOVE MOUTH
COW CASTLE CREEK
ORANGEBURG COUNTY
BOWMAN, SOUTH CAROLINA
FLOOD PROFILES
EXISTING CONDITIONS

FIGURE A-6

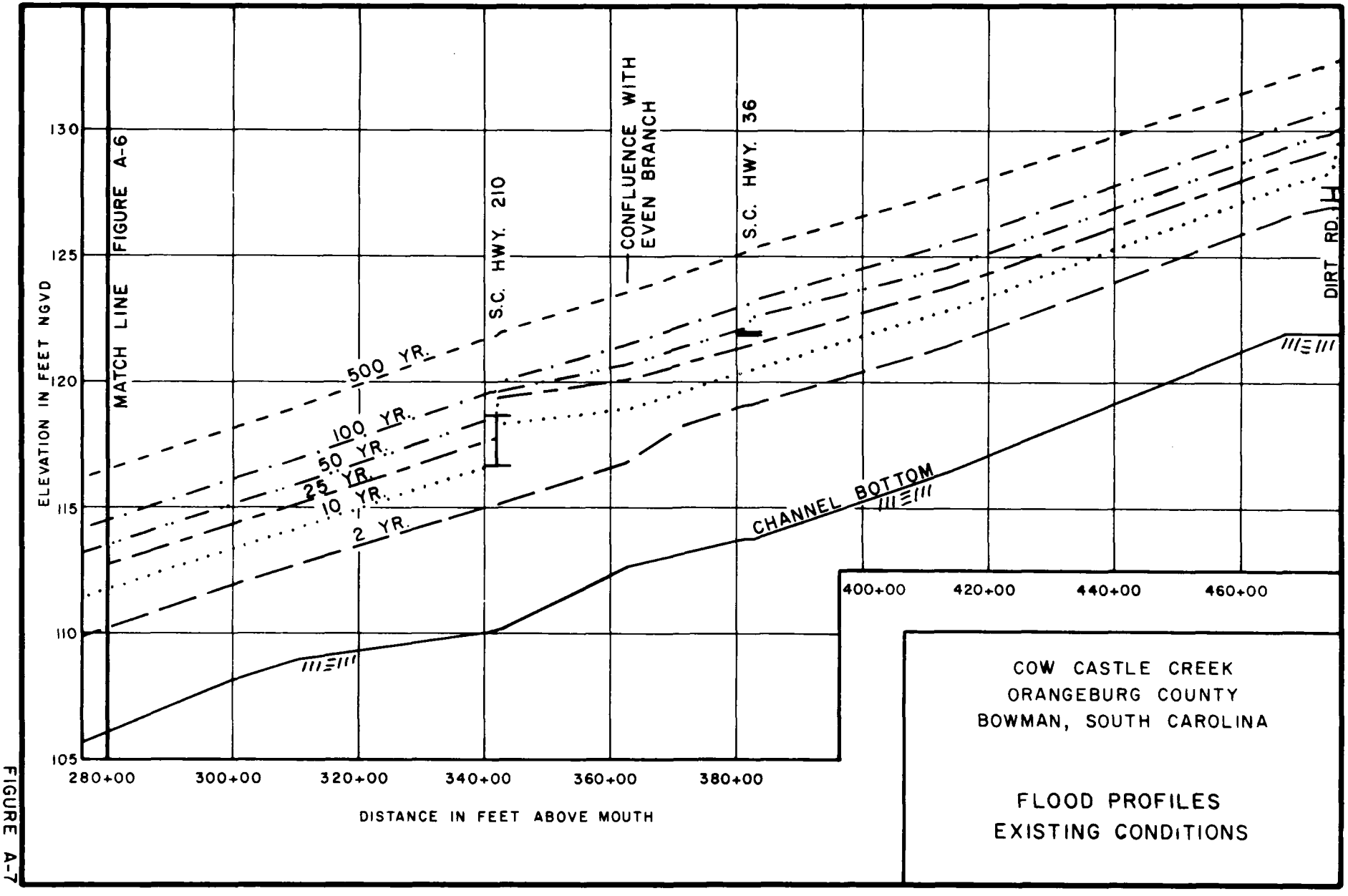

ELEVATION IN FEET NGVD
130
125
120
115
110
105
MATCH LINE FIGURE A-6
S.C. HWY. 210
CONFLUENCE WITH EVEN BRANCH
S.C. HWY. 36
DIRT RD.
500 YR.
100 YR.
50 YR.
25 YR.
10 YR.
2 YR.
CHANNEL BOTTOM
280+00
300+00
320+00
340+00
360+00
380+00
400+00
420+00
440+00
460+00
DISTANCE IN FEET ABOVE MOUTH
COW CASTLE CREEK
ORANGEBURG COUNTY
BOWMAN, SOUTH CAROLINA
FLOOD PROFILES
EXISTING CONDITIONS

FIGURE A-7

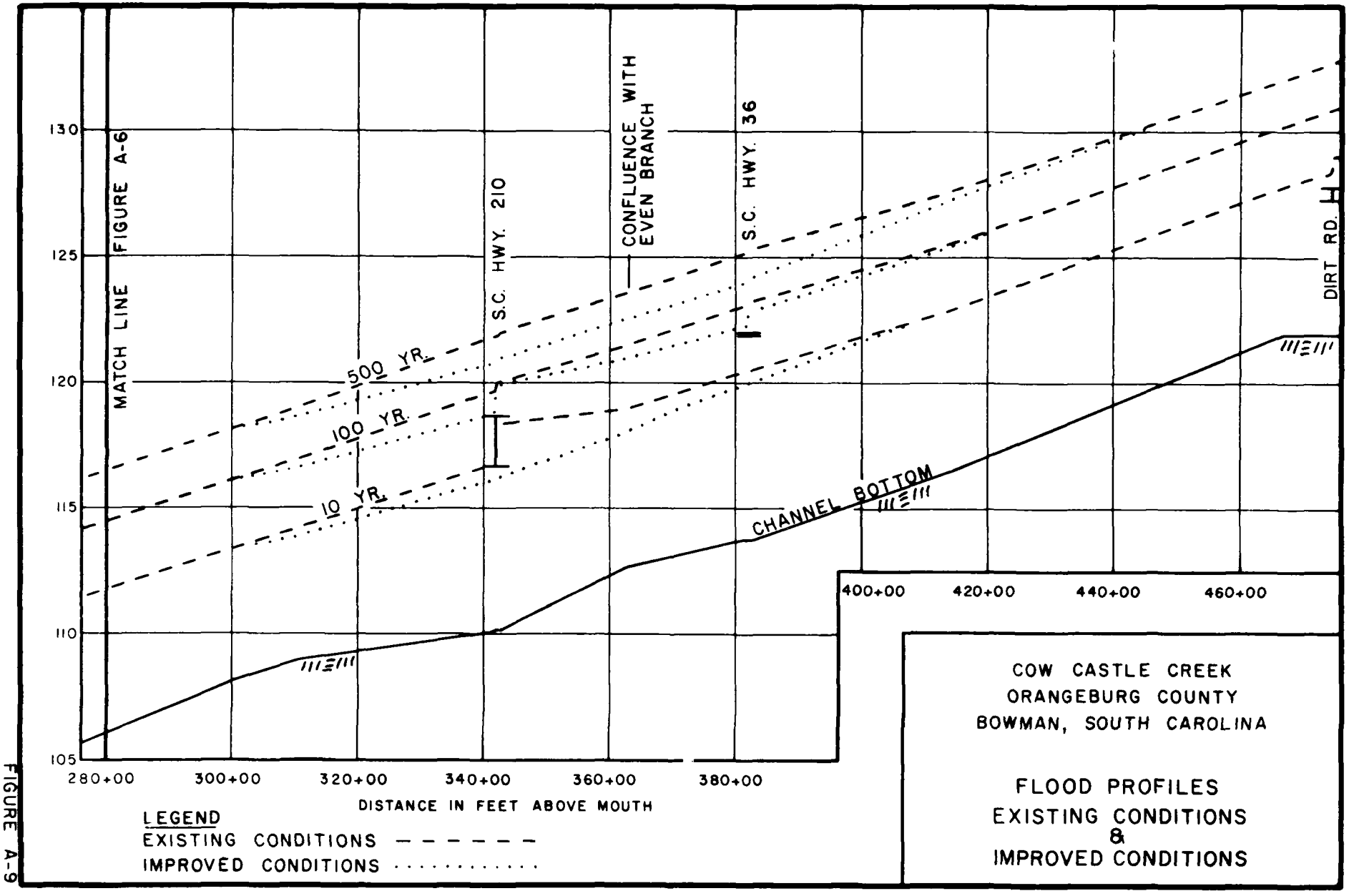

MATCH LINE FIGURE A-6
S.C. HWY. 210
CONFLUENCE WITH EVEN BRANCH
S.C. HWY. 36
DIRT RD.
500 YR.
100 YR.
10 YR.
CHANNEL BOTTOM
130
125
120
115
110
105
280+00
300+00
320+00
340+00
360+00
380+00
400+00
420+00
440+00
460+00
DISTANCE IN FEET ABOVE MOUTH
LEGEND
EXISTING CONDITIONS
IMPROVED CONDITIONS
COW CASTLE CREEK
ORANGEBURG COUNTY
BOWMAN, SOUTH CAROLINA
FLOOD PROFILES
EXISTING CONDITIONS
&
IMPROVED CONDITIONS

FIGURE A-9

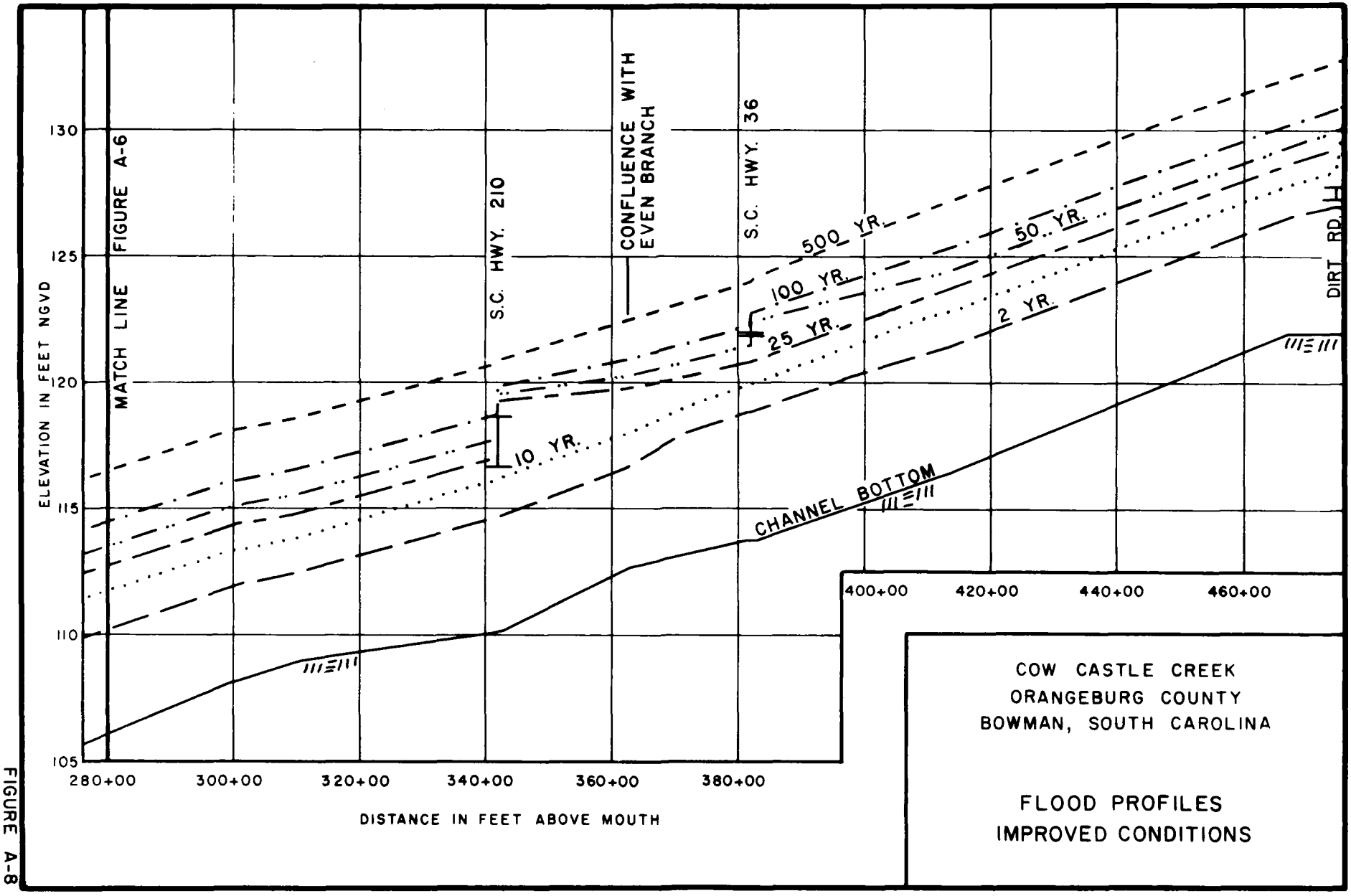
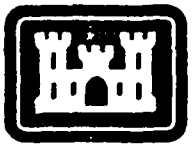

ELEVATION IN FEET NGVD
130
125
120
115
110
105
MATCH LINE FIGURE A-6
S.C. HWY. 210
CONFLUENCE WITH EVEN BRANCH
S.C. HWY. 36
DIRT RD.
500 YR.
100 YR.
50 YR.
25 YR.
10 YR.
2 YR.
CHANNEL BOTTOM
280+00
300+00
320+00
340+00
360+00
380+00
400+00
420+00
440+00
460+00
DISTANCE IN FEET ABOVE MOUTH
COW CASTLE CREEK
ORANGEBURG COUNTY
BOWMAN, SOUTH CAROLINA
FLOOD PROFILES
IMPROVED CONDITIONS

FIGURE A-8

10. Even Branch is to be cleared by local interests as part of this project to reduce damages in the Town of Bowman. Since no analyses were performed on Even Branch, the conservative assumption that stage reductions would be limited to those at its confluence with Cow Castle Creek was made for the purpose of deriving benefits. These stage reductions were applied to Flood Insurance Study profiles for the Town of Bowman.



US Army Corps
of Engineers
Charleston District

COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA

APPENDIX B

ECONOMICS OF ALTERNATIVE PLAN

APPENDIX B

ECONOMICS OF ALTERNATIVE PLAN

TABLE OF CONTENTS

APPENDIX B

ECONOMICS OF ALTERNATIVE PLAN

TABLE OF CONTENTS (CONT'D)

LIST OF TABLES

COW CASTLE CREEK

APPENDIX B

Economics of Alternative Plan

1. The purpose of this section is to present detailed economic data used in measuring beneficial contributions to national economic development from the recommended flood hazard reduction plan. The material presented covers damages, benefits, and costs of the recommended plan.

INTRODUCTION

2. Economic feasibility of the plan was established by first computing equivalent average annual flood damages expected to occur if no corrective action is taken. (Without project condition). Then, damages were computed assuming that clearing and snagging would be undertaken along selected channel and floodway reaches. This identifies the residual damage which would remain after construction. (With project condition).

Benefits are calculated by subtracting the damage expected under with project conditions from that expected under without project conditions.

3. The values given to damages, benefits and costs at their time of accrual are made comparable by conversion to an equivalent time basis using an appropriate interest or discount rate. The interest rate of 7 7/8% annually was used in the formulation and evaluation. Future damages, benefits, and costs were discounted to the year 1985, and amortized over a 50-year period to arrive at the average annual equivalent figures.

4. Development of costs and benefits follows standard Corps of Engineers procedures. Estimated costs include the value of material, equipment, and services used in implementing the selected plan. Benefits are computed by using standard damage-probability relationships. Damage-probability values are derived from flood damage survey data and discharge-frequency, stage-discharge, stage-damage, stage-frequency, and damage-frequency relationships.

FLOOD DAMAGE

5. The following discussion of flood damage proceeds from a general description of the nature and extent of flood losses to the presentation of detailed flood damage and average annual damage data. The procedure utilized in developing average annual equivalent values is also described.

NATURE AND EXTENT OF FLOOD LOSSES

6. Flood damages along Cow Castle Creek and Even Branch are both tangible and intangible in nature. Tangible damages are those which can be measured in monetary terms. These include such things as direct physical damage to

property and improvements, emergency costs, and business or financial losses. Intangible damages are not readily evaluated in monetary terms. These include such things as danger to human life, added inconvenience and human discomfort, injury and exposure during floods, interruption of basic utilities and community activities, and degradation of the natural environment and aesthetic quality.

7. Losses to residential property include damage to the main structure and auxiliary buildings, heating and cooling systems, electrical installations, and other fixed or built-in equipment. Contents subject to damage include such items as floor covering, appliances, household furnishings, mechanical and electrical equipment, and personal items.

STAGE-DAMAGE RELATIONSHIPS

8. Stage-damage relationships portray the probable damage that will occur under different depths of flooding. This can be expressed as either a percentage of the total value of damageable property or as the probable dollar loss expected.

9. Charleston District has developed depth-percent damage relationships for the types of residential structures and their contents which are most prevalent throughout South Carolina. These data were developed by detailed inspection of structures and contents. The detailed depth-damage information was based on known values of contents and structural components. Percent damage to structures of contents was computed by determining replacement value or repair replacement value of the component.

10. The percent damage relationship for commercial property was developed by determining the damage that would be caused to the property for each foot of flooding and dividing by the total value of the property.

11. Depth-percent damage data were integrated with hydrologic stage data to derive stage-damage for each structure at its respective mean sea level location along the stream profile. The actual damage at any depth was then determined by multiplying the structure or content value by the percent figure at the selected depth.

STAGE-DISCHARGE RELATIONSHIPS

12. Stage-discharge relationships portray a stream's ability to carry flow at different depths. Stage is usually measured in elevations taken from mean sea level, while discharge is given in cubic feet per second. Engineering surveys were conducted to establish cross sections at selected points along the stream. For a flood of a given magnitude the stage-discharge relationship will tell how deep the flow will be at each cross section. Procedures used in establishing stage-discharge relationships are discussed in Appendix A.

DISCHARGE-FREQUENCY RELATIONSHIPS

13. Discharge-frequency relationships describe the probable frequency of occurrence of varying streamflows. The methodology used in determining the relationships is described in Appendix A.

STAGE-FREQUENCY RELATIONSHIPS

14. Stage-frequency Relationships describe the probable frequency of occurrence in any year of the water level reaching various elevations. This relationship is established by combining data from the stage-discharge and discharge-frequency relationships. This is accomplished by selecting

points from these two relationships which have the same discharge and constructing the state-frequency relationship from the corresponding points. Stage-frequency profiles for selected floods are shown in Appendix A.

DAMAGE-FREQUENCY RELATIONSHIPS

15. Damage-frequency relationships portray the probable frequency of occurrence of flood damages of varying magnitudes. This is derived by combining the stage-damage and stage-frequency data. Average annual damages can then be estimated by plotting a curve from the damage-frequency data and calculating the area under the curve. Average annual damage can also be computed mathematically.

EQUIVALENT AVERAGE ANNUAL DAMAGE

16. Employment of the relationships described above produces average annual damage for any given year. If this were the first year of a project evaluation period, and conditions remained the same in the future, this would be the equivalent average annual damage for the entire project life. However, it is common for conditions to change; i.e., damageable property in the flood plain may increase or decrease, urbanization upstream may cause increased runoff, or the channel itself may change. For these and other reasons it is necessary when analyzing flood damage over a period of time to compute expected annual damage for each year conditions change. This is accomplished by employing data for selected future years in the integration of the state, damage, discharge, and frequecny relationships. The average annual damage for each future year is then discounted back to the first year of the evaluation at a selected rate of interest and amortized over the entire period of analysis to arrive at the equivalent average annual damage.

MEASUREMENT OF FLOOD DAMAGE

17. Engineering surveys were conducted to establish the ground and first floor elevations of each structure located within the flood plain. The number of floors for each structure was recorded during the field survey. Each structure location was referenced on a map relative to its position along the stream profile.

18. The value of each property located in the flood plain was determined by a field survey conducted by Corps personnel. An informal survey of homeowners was conducted to determine the value of contents. Based upon the occupant's judgement, it was determined that the average value of residential contents amounts to 60 percent of the structure values.

19. The value of residential contents per unit is expected to increase over time with increases in affluence (an increase in per capita income in real terms). Increases in content values during the evaluation period are projected on the basis of the anticipated growth of per capita income for Orangeburg County, South Carolina. Such increases are projected to continue until residential content values reach a maximum of 75 percent of structural value. The unit values of structures are not increased over time for affluence.

20. Participation in the Flood Disaster Protection Act of 1973 (P.L. 93-234) requires local adoption and certification by the Flood Insurance Administration of land use reghulations that would reuqire, as a minimum, that all new and replacement residential structures in the 100-year flood plain have the first floor elevated to or above the 100-year flood elevation. The Town of Bowman is participating in the Flood Insurance Program.

21. The data and principles described heretofore are utilized as basic components of a computer program to calculate flood damage. This program

analyzes each building individually to determine the expected depth of flooding for various flood events with particular recurrence intervals. Based on the location of the building along the stream profile, the type of building, its value, the depth-damage relationship for the type building, and the expected depth of flooding in relation to the first floor elevation, the expected damage to the building and its contents can be computed. Several single occurrence events are combined through the use of probability analysis to provide the average annual damage.

WITHOUT PROJECT CONDITION

22. The primary problem caused by the flooding of Cow Castle Creek and Even Branch is the inundation of residential property. About 26 single family residential properties, six mobile homes, one lumber mill, one church, and two commercial structures receive damage from flooding on the two creeks. About ten houses, two mobile homes and one lumber mill are subject to flooding from Cow Castle Creek. About 16 houses, four mobile homes, one church, and two commercial structures are subject to flooding from Even Branch.

23. The 1983 value of all residential structures which are subject to flood damages on Cow Castle Creek and Even Branch is estimated to be about $292,000 and $350,000, respectively. The value of contents is estimated to be about $175,000 and $210,000 for the residences on Cow Castle Creek and Even Branch, respectively.

24. Flood water inundation currently causes average annual damages of $12,300 on Cow Castle Creek and $20,000 on Even Branch as shown in Tables B-1 and B-2. Total average annual damages are estimated to be $32,300 as shown in Table B-3. A 500-year frequency flood would cause an

estimated monetary loss of $440,800, based on current price estimates. Of these damages, $296,400 would occur to structures on Even Branch and the remaining $144,400 in damages to development on Cow Castle Creek. An additional $800 annually in agricultural loss occurs from crop damage on Cow Castle Creek for a total annual damage of $33,100.

BENEFITS

25. Average annual benefits from inundation reduction will amount to $4,260 on Cow Castle Creek and $18,090 on Even Branch for a total of $22,350 in damage reduction to structures and content as shown in Tables B-4 through B-7. As shown by Table B-6, approximately $11,400 of the benefits on Even Branch can not be realized without the outlet provided by improving Cow Castle Creek. An additional $500 agricultural benefit would also be expected annually for a total project benefit of $22,850.

26. Average annual residual damages with the project were estimated to about $8,000 on Cow Castle Creek and about $1,900 on Even Branch for a combined total damage of $9,900 (See Tables B-9 through B-12). An additional residual damage of $300 annual would result from crop damage.

TABLE B-1
AVERAGE ANNUAL DAMAGE
WITHOUT PROJECT
COW CASTLE CREEK ONLY
ORANGEBURG COUNTY, SOUTH CAROLINA

Type Damage	Damages (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
RESIDENTIAL					
Structure	$6.90	$6.90	$6.90	$6.90	$6.90
Content	1.17	1.29	1.74	2.20	1.76
Other	1.86	1.86	1.86	1.86	1.86
TOTAL RESIDENTIAL DAMAGE	$9.93	$10.05	$10.50	$10.96	$10.52
COMMERCIAL					
Structure	$0.13	$0.13	$0.13	$0.13	$0.13
Content	0.05	0.05	0.05	0.05	0.05
Other	0.01	0.01	0.01	0.01	0.01
TOTAL COMMERCIAL DAMAGE	$0.19	$0.19	$0.19	$0.19	$0.19
INDUSTRIAL					
Structure	$0.40	$0.40	$0.40	$0.40	$0.40
Content	0.70	0.70	0.70	0.70	0.70
Other	0.52	0.52	0.52	0.52	0.52
TOTAL INDUSTRIAL DAMAGE	$1.62	$1.62	$1.62	$1.62	$1.62
SUMMARY DAMAGE					
Structure	$ 7.43	$ 7.43	$ 7.43	$ 7.43	$ 7.43
Content	1.92	2.04	2.49	2.95	2.51
Other	2.39	2.39	2.39	2.39	2.39
TOTAL URBAN DAMAGE COW CASTLE CREEK	$11.74	$11.86	$12.31	$12.77	$12.33

TABLE B-2
AVERAGE ANNUAL DAMAGE
WITHOUT PROJECT
EVEN BRANCH ONLY
ORANGEBURG COUNTY, SOUTH CAROLINA

Type Damage	Damages (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
RESIDENTIAL					
Structure	$12.93	$12.93	$12.93	$12.93	$12.93
Content	0.95	1.05	1.42	1.79	1.43
Other	2.48	2.48	2.48	2.48	2.48
TOTAL RESIDENTIAL DAMAGE	$16.36	$16.46	$16.83	$17.20	$16.84
COMMERCIAL					
Structure	$2.58	$2.58	$2.58	$2.58	$2.58
Content	0.44	0.44	0.44	0.44	0.44
Other	0.10	0.10	0.10	0.10	0.10
TOTAL COMMERCIAL DAMAGE	$3.12	$3.12	$3.12	$3.12	$3.12
SUMMARY DAMAGE					
Structure	$15.51	$15.51	$15.51	$15.51	$15.51
Content	1.39	1.49	1.86	2.23	1.87
Other	2.58	2.58	2.58	2.58	2.58
TOTAL	$19.48	$19.58	$19.95	$20.32	$19.96

TABLE B-3
AVERAGE ANNUAL DAMAGE
WITHOUT PROJECT
COW CASTLE CREEK AND EVEN BRANCH1/
ORANGEBURG COUNTY, SOUTH CAROLINA

Type Damage2/	Damages (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
URBAN					
Structure	$22.94	$22.94	$22.94	$22.94	$22.94
Content	3.31	3.53	4.35	5.18	4.38
Other	4.97	4.97	4.97	4.97	4.97
TOTAL	$31.22	$31.44	$32.26	$33.09	$32.29

1/ From Summary of Tables B-1 and B-2.

2/ Residential, commercial, and industrial damages.

TABLE B-4

AVERAGE ANNUAL BENEFITS

COW CASTLE CREEK ONLY

COW CASTLE CREEK IMPROVED - EVEN BRANCH IMPROVED

ORANGEBURG COUNTY, SOUTH CAROLINA

Type Benefits	Benefits (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
URBAN					
RESIDENTIAL					
Structure	$2.66	$2.66	$2.66	$2.66	$2.66
Content	0.44	0.48	0.65	0.82	0.65
Other	0.26	0.26	0.26	0.26	0.26
TOTAL RESIDENTIAL BENEFITS	$3.36	$3.40	$3.57	$3.74	$3.57
COMMERCIAL					
Structure	$0.04	$0.04	$0.04	$0.04	$0.04
Content	0.03	0.03	0.03	0.03	0.03
Other	0.01	0.01	0.01	0.01	0.01
TOTAL COMMERCIAL BENEFITS	$0.08	$0.08	$0.08	$0.08	$0.08
INDUSTRIAL					
Structure	$0.20	$0.20	$0.20	$0.20	$0.20
Contents	0.30	0.30	0.30	0.30	0.30
Other	0.11	0.11	0.11	0.11	0.11
TOTAL INDUSTRIAL BENEFITS	$0.61	$0.61	$0.61	$0.61	$0.61
SUMMARY OF URBAN BENEFITS					
Structure	$2.90	$2.90	$2.90	$2.90	$2.90
Content	0.77	0.81	0.98	1.15	0.98
Other	0.38	0.38	0.38	0.38	0.38
TOTAL BENEFITS	$4.05	$4.09	$4.26	$4.43	$4.26

TABLE B-5
AVERAGE ANNUAL BENEFITS
EVEN BRANCH ONLY
EVEN BRANCH IMPROVED - COW CASTLE CREEK UNIMPROVED1/
ORANGEBURG COUNTY, SOUTH CAROLINA

Type Benefits	Benefits (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
RESIDENTIAL					
Structure	$ 4.37	$ 4.37	$ 4.37	$ 4.37	$ 4.37
Content	0.32	0.35	0.48	0.60	0.48
Other	0.86	0.86	0.86	0.86	0.86
TOTAL RESIDENTIAL BENEFITS	$ 5.55	$ 5.58	$ 5.71	$ 5.83	$ 5.71
COMMERCIAL					
Structure	$0.83	$0.83	$0.83	$0.83	$0.83
Content	0.13	0.13	0.13	0.13	0.13
Other	0.03	0.03	0.03	0.03	0.03
TOTAL COMMERCIAL BENEFITS	$0.99	$0.99	$0.99	$0.99	$0.99
SUMMARY OF BENEFITS					
Structure	$ 5.20	$ 5.20	$ 5.20	$ 5.20	$ 5.20
Content	0.45	0.48	0.61	0.73	0.61
Other	0.89	0.89	0.89	0.89	0.89
TOTAL BENEFITS	$ 6.54	$ 6.57	$ 6.70	$ 6.82	$ 6.70

1/ These incremental benefits on Even Branch will be realized with the improvement of Even Branch only and are not contingent on the improvement of Cow Castle Creek.

TABLE B-6

ADDITIONAL INCREMENTAL AVERAGE ANNUAL BENEFITS

EVEN BRANCH ONLY

EVEN BRANCH IMPROVED - COW CASTLE CREEK IMPROVED[1]/

ORANGEBURG COUNTY, SOUTH CAROLINA

Type Benefits	Benefits (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
RESIDENTIAL					
Structure	$ 7.43	$ 7.43	$ 7.43	$ 7.43	$ 7.43
Content	0.54	0.60	0.81	1.02	0.81
Other	1.46	1.46	1.46	1.46	1.46
TOTAL RESIDENTIAL BENEFITS	9.43	9.49	9.70	9.91	9.70
COMMERCIAL					
Structure	$1.41	$1.41	$1.41	$1.41	$1.41
Content	0.23	0.23	0.23	0.23	0.23
Other	0.05	0.05	0.05	0.05	0.05
TOTAL COMMERCIAL BENEFITS	$1.69	$1.69	$1.69	$1.69	$1.69
SUMMARY OF BENEFITS					
Structure	$ 8.84	$ 8.84	$ 8.84	$ 8.84	$ 8.84
Content	0.77	0.83	1.04	1.25	1.04
Other	1.51	1.51	1.51	1.51	1.51
TOTAL BENEFITS	$11.12	$11.18	$11.39	$11.60	$11.39

1/ These incremental benefits on Even Branch will not be realized without the outlet provided by the improvement on Cow Castle Creek.

TABLE B-7
AVERAGE ANNUAL BENEFITS
EVEN BRANCH ONLY
EVEN BRANCH IMPROVED - COW CASTLE CREEK IMPROVED[1/]
ORANGEBURG COUNTY, SOUTH CAROLINA

Type Benefits	Benefits (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
RESIDENTIAL					
Structure	$11.80	$11.80	$11.80	$11.80	$11.80
Content	0.86	0.95	1.29	1.62	1.29
Other	2.32	2.32	2.32	2.32	2.32
TOTAL RESIDENTIAL BENEFITS	$14.98	$15.07	$15.41	$15.74	$15.41
COMMERCIAL					
Structure	$2.24	$2.24	$2.24	$2.24	$2.24
Content	0.36	0.36	0.36	0.36	0.36
Other	0.08	0.08	0.08	0.08	0.08
TOTAL COMMERCIAL BENEFITS	$ 2.68	$ 2.68	$ 2.68	$ 2.68	$ 2.68
SUMMARY OF BENEFITS					
Structure	$14.04	$14.04	$14.04	$14.04	$14.04
Content	1.22	1.31	1.65	1.98	1.65
Other	2.40	2.40	2.40	2.40	2.40
TOTAL BENEFITS	$17.66	$17.75	$18.09	$18.42	$18.09

1/ These are the total benefits on Even Branch which will result from the improvement of both Even Branch and Cow Castle Creek. Total of Tables B-5 and B-6.

TABLE B-8
COMBINED SUMMARY OF
AVERAGE ANNUAL BENEFITS
COW CASTLE CREEK IMPROVED - EVEN BRANCH IMPROVED 1/
ORANGEBURG COUNTY, SOUTH CAROLINA

Type Benefits2/	Benefits (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
URBAN					
Structure	$16.94	$16.94	$16.94	$16.94	$16.94
Content	1.99	2.12	2.63	3.13	2.63
Other	2.78	2.78	2.78	2.78	2.78
TOTAL	$21.71	$21.84	$22.35	$22.85	$22.35

1/ From Summary of Tables B-4 and B-7.

2/ Residential, commercial, and industrial damages.

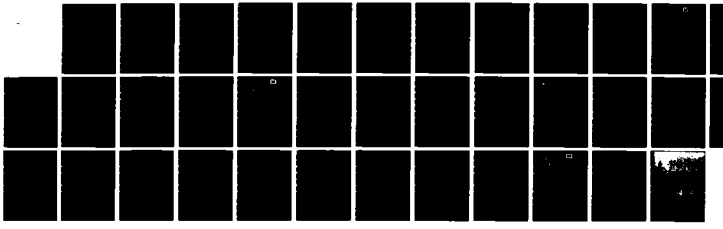
TABLE B-9
AVERAGE ANNUAL RESIDUAL DAMAGE
COW CASTLE CREEK ONLY
COW CASTLE CREEK IMPROVED - EVEN BRANCH IMPROVED[1]/
ORANGEBURG COUNTY, SOUTH CAROLINA

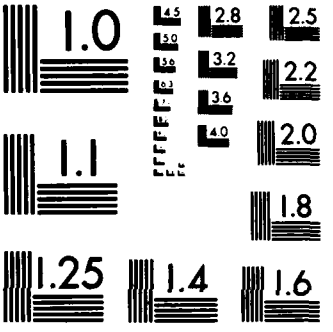
Type Damage	Damages (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
RESIDENTIAL					
Structure	$4.24	$4.24	$4.24	$4.24	$4.24
Content	0.73	0.81	1.09	1.38	1.11
Other	1.60	1.60	1.60	1.60	1.60
TOTAL RESIDENTIAL DAMAGE	$6.57	$6.65	$6.93	$7.22	$6.95
COMMERCIAL					
Structure	$0.09	$0.09	$0.09	$0.09	$0.09
Content	0.02	0.02	0.02	0.02	0.02
Other	.0	.0	.0	.0	.0
TOTAL COMMERCIAL DAMAGE	$0.11	$0.11	$0.11	$0.11	$0.11
INDUSTRIAL					
Structure	$0.20	$0.20	$0.20	$0.20	$0.20
Content	0.40	0.40	0.40	0.40	0.40
Other	0.41	0.41	0.41	0.41	0.41
TOTAL INDUSTRIAL DAMAGE	$1.01	$1.01	$1.01	$1.01	$1.01
SUMMARY DAMAGE					
Structure	$ 4.53	$ 4.53	$ 4.53	$ 4.53	$ 4.53
Content	1.15	1.23	1.51	1.80	1.53
Other	2.01	2.01	2.01	2.01	2.01
TOTAL URBAN DAMAGE COW CASTLE CREEK	$7.69	$7.77	$8.05	$8.34	$8.07

1/ Table B-1 minus Table B-4

AD-A132 224 COW CASTLE CREEK ORANGEBURG COUNTY SOUTH CAROLINA ENVIRONMENTAL ASSESSMENT(U) CORPS OF ENGINEERS CHARLESTON SC CHARLESTON DISTRICT JUL 83 2/2

UNCLASSIFIED F/G 13/2 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

TABLE B-10

AVERAGE ANNUAL RESIDUAL DAMAGE

EVEN BRANCH ONLY

EVEN BRANCH IMPROVED - COW CASTLE CREEK UNIMPROVED[1/]

ORANGEBURG COUNTY, SOUTH CAROLINA

Type Damage	Damages (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
RESIDENTIAL					
Structure	$8.56	$8.56	$8.56	$8.56	$8.56
Content	0.63	0.70	0.94	1.19	0.95
Other	1.62	1.62	1.62	1.62	1.62
TOTAL RESIDUAL RESIDENTIAL DAMAGE	$10.81	$10.88	$11.12	$11.37	$11.13
COMMERCIAL					
Structure	$1.75	$1.75	$1.75	$1.75	$1.75
Content	0.31	0.31	0.31	0.31	0.31
Other	0.07	0.07	0.07	0.07	0.07
TOTAL RESIDUAL COMMERCIAL DAMAGE	$2.13	$2.13	$2.13	$2.13	$2.13
SUMMARY OF RESIDUAL DAMAGE					
Structure	$10.31	$10.31	$10.31	$10.31	$10.31
Content	0.94	1.01	1.25	1.50	1.26
Other	1.69	1.69	1.69	1.69	1.69
TOTAL RESIDUAL DAMAGE	$12.94	$13.01	$13.25	$13.50	$13.26

1/ Table B-2 Minus Table B-5.

TABLE B-11
AVERAGE ANNUAL RESIDUAL DAMAGE
EVEN BRANCH ONLY
EVEN BRANCH IMPROVED - COW CASTLE CREEK IMPROVED1/
ORANGEBURG COUNTY, SOUTH CAROLINA

Type Damage	Damages (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
RESIDENTIAL					
Structure	$1.13	$1.13	$1.13	$1.13	$1.13
Content	0.09	0.10	0.13	0.17	0.14
Other	0.16	0.16	0.16	0.16	0.16
TOTAL RESIDUAL RESIDENTIAL DAMAGE	$1.38	$1.39	$1.42	$1.46	$1.43
COMMERCIAL					
Structure	$0.34	$0.34	$0.34	$0.34	$0.34
Content	0.08	0.08	0.08	0.08	0.08
Other	0.02	0.02	0.02	0.02	0.02
TOTAL RESIDUAL COMMERCIAL DAMAGE	$0.44	$0.44	$0.44	$0.44	$0.44
SUMMARY OF RESIDUAL DAMAGE					
Structure	$1.47	$1.47	$1.47	$1.47	$1.47
Content	0.17	0.18	0.21	0.25	0.22
Other	0.18	0.18	0.18	0.18	0.18
TOTAL RESIDUAL DAMAGE	$1.82	$1.83	$1.86	$1.90	$1.87

1/ Table B-2 Minus Table B-7

TABLE B-12
COMBINED SUMMARY OF
AVERAGE ANNUAL RESIDUAL DAMAGE
COW CASTLE CREEK IMPROVED - EVEN BRANCH IMPROVED1/
ORANGEBURG COUNTY, SOUTH CAROLINA

Type Damage	Damages (1983 x $1,000) 1982	1985	1995	2005-2035	Average Annual Equivalent
URBAN					
Structure	$6.00	$6.00	$6.00	$6.00	$6.00
Content	1.32	1.41	1.72	2.05	1.75
Other	2.19	2.19	2.19	2.19	2.19
TOTAL	$9.51	$9.60	$9.91	$10.24	$9.94

1/ Table B-3 Minus Table B-8

PROJECT FIRST COST

27. Evaluation of project first costs is in compliance with current Engineering Regulations. Estimated construction cost for the proposed clearing and snagging of Cow Castle Creek and Even Branch were obtained by first estimating unit quantities for identifiable construction items (i.e., acres to be cleared). These quantities were multiplied by unit prices to obtain the total cost for each of the items. Unit price estimates were based on costs incurred on similar type projects, updated to reflect 1983 dollar values. An allowance of 20 percent of the estimated construction cost was added for contingencies. Engineering and design costs and costs for supervision and administration were also estimated on the basis of experience for similar type projects.

28. Estimates of costs for obtaining easements for construction were based on flood plain land values. These values were developed by Corp's personnel.

29. A detailed itemization of cost estimates is shown in Table B-13. It can be seen that the total first cost amounts to $158,000.

TABLE B-13
DETAILED COST ESTIMATE
CLEARING AND SNAGGING
1983 DOLLARS

ITEM	COW CASTLE	EVEN BRANCH
FIRST COST		
Mob. and Demob. -		
1 Job L.S.	$ 5,000	$ 2,000
Clearing and Snagging -		
1.5 mi. @ $42,000	$ 63,000	
1.7 mi. @ $2,500		$ 4,300
Seeding -		
35 acres @ $600	$ 21,000	
2 acres @ $600		$ 1,200
SUBTOTAL	$ 89,000	$ 7,500
Contingencies (20%)	18,000	1,500
Contract Price	$107,000	$ 9,000
Engineering & Design	14,000	1,200
Supervision & Administration	11,000	800
Construction Cost	$132,000	$11,000
Lands (Easement) -		
L.S.	15,000[1]/	
TOTAL FIRST COST	$147,000	$11,000

1/ Includes cost of easements for Even Branch.

PROJECT ANNUAL COST

30. Estimates of annual costs for the proposed clearing and snagging along Cow Castle Creek and Even Branch are based on a 50-year period of analysis. Interest during construction was not included since the construction period will take less than a year and benefits can accrue as construction takes place. Interest and amortization charges are based on an interest rate of 7 7/8 percent. Estimates of annual operation and maintenance costs are also included in the total annual charges.

31. Based on the first cost of $158,000, the annual cost of construction amounts to $12,700. Adding this to the annual operation and maintenance cost of $4,300 results in a total annual cost of $17,000 (Table B-14).

BENEFIT TO COST COMPARISON

32. The benefit-to-cost comparison for the selected plan of action is based on the economic conditions expected to occur in the future. Specifically, no additional development is expected in the flood plain. Content values of those residential properties currently existing in the flood plain are expected to increase to equal 75 percent of structural values by the year 2005. Based on an average annual benfit of $22,850 and an average annual cost of $17,000 the benefit-to-cost ratio For the recommended plan of action is 1.34 to 1.0. The excess of annual benefits over costs amount to $5,850 as shown in Table B-14.

TABLE B-14

BENEFIT-TO-COST ANALYSIS
COW CASTLE CREEK AND EVEN BRANCH
ORANGEBURG COUNTY, SOUTH CAROLINA

BENEFIT-TO-COST-RATIOS

LOCATION	AVERAGE ANNUAL BENEFITS	ANNUAL CHARGES
Cow Castle Creek		
Urban		
Cow Castle Creek	$ 4,260	
Even Branch	11,390	
(Attributable to Cow Castle)		
TOTAL URBAN	$15,650	
Agriculture	500	
TOTAL BENEFITS	$16,150	$15,400
Even Branch		
Urban	6,700	1,600
TOTAL BENEFITS	$22,850	$17,000
EXCESS BENEFITS		$ 5,850

BENEFIT-TO-COST-RATIO = $22,850 ÷ $17,000 = 1.34 to 1

SENSITIVITY ANALYSIS

VALUE PER STRUCTURE

33. The analysis of the selected plan was based on the assumption that no future development will take place in the flood plain. The 1983 value of structures currently in the flood plain are assumed to remain constant throughout the life of the project. The value of residential contents was assumed to currently equal 60 percent of the structure value and projected to increase to 75 percent by the year 2005. The project is justified under the assumption that there would be no increase in future content values, since the benefits exclusive of those expected from contents amounts to $17,500 annually, which is more than equal to the annual cost. It is thus apparent that content values far below that used in the analysis would produce a favorable benefit to cost comparison.

BREAK EVEN YEARS

34. The annual project benefits will exceed the annual project costs in the base year.

COST ALLOCATION

35. All cost associated with the implementation of the proposed project have been allocated to flood control.

COST APPORTIONMENT

36. The traditional method of apportioning structural costs between Federal and non-Federal interests is based on standard requirements established for continuing authority projects. Under this policy non-Federal interests are required to furnish all lands, easements, and rights-of-way required for project construction and proper project maintenance, including the total first cost of the work on Even Branch. Non-Federal interests are also required to bear the costs of modifications to all utilities and highway crossings, if required, for project construction. No utility or highway modifications, however, are required by the selected plan. In addition, the local sponsor must operate and maintain the project after construction in accordance with Federal requirements. The Federal government would be responsible for all flood control construction costs, except the Even Branch costs, including costs incurred in performing feasibility investigations and preparing detail construction plans. A breakdown of Federal and non-Federal cost is contained in Table B-15. Annual maintenance costs, which would be a local responsibility, are in addition to those shown in Table B-15.

TABLE B-15
APPORTIONMENT OF FIRST COST

Item	Total First Cost	Federal Cost	Non-Federal Cost
Construction	$143,000	$132,000	$11,000
Lands (Easements)	15,000	-	15,000
TOTALS	$158,000	$132,000	$26,000

US Army Corps
of Engineers
Charleston District

APPENDIX C

COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA

CONSTRUCTION PLANS

AND

MAINTENANCE PROGRAM

APPENDIX C

CONSTRUCTION PLANS AND MAINTENANCE PROGRAM

TABLE OF CONTENTS

COW CASTLE CREEK

APPENDIX C

CONSTRUCTION PLANS AND MAINTENANCE PROGRAM

1. The purpose of this appendix is to briefly describe the work requirements necessary for improvements on Cow Castle Creek. At the option of the local sponsor the scope of the construction contract may be expanded to include work on Even Branch, provided the local sponsor provides necessary funds to cover the cost of improvements on this tributary. This work on Even Branch is necessary for full realization of project benefits and must be accomplished as part of the total project. Local sponsors may also choose to perform this work in-house, or by separate contract. Work on Even Branch will only consist of cleaning the existing channel through town, for a distance of approximately 1.7 miles. More extensive work is required on Cow Castle Creek as described in the main report and in the following paragraphs.

SCOPE

General

2. The contractor would furnish all plant, labor, material, and equipment and would perform all operations in connection with the work required for clearing and snagging as indicated by plans and specifications. Because of the great concern to preserve remaining riparian and flood plain vegetation, appropriate equipment would be specified.

Conduct of Work

3. The contractor would maintain and protect the work in a satisfactory condition at all times until the final completion and acceptance of all work under the contract.

CLEARING AND SNAGGING

GENERAL REQUIREMENTS

4. All trees, stumps, roots, drift, debris, brush and like material would be removed from the existing channel and an additional strip to the left of the channel, looking downstream, for a total width of 200 feet including the channel and its left and right banks (see exceptions noted in paragraph 5).

SPECIAL REQUIREMENTS

5. The contractor would remove the trees, snags, stumps, logs, and like materials that are anchored, floating, or submerged, and other debris above the natural bottom of the stream and between the stream's natural banks (except as noted in paragraph 6). Accumulations of limbs, branches, trash and debris causing partial or complete blockage of the natural channel would be removed to restore the natural channel to an essentially unobstructed condition. Minor amounts of shoaled material that may have accumulated behind or below the blockages, and which would constitute a flow restriction, would also be removed. Logs, down treetops, limbs, and uprooted trees within the 200-foot clearing width would be removed.

Snagging and clearing shall include the removal of the following trees causing obstruction to flow in the stream channel and adjacent clearing width: (1) dead trees, (2) down trees, (3) trees in imminent danger of falling, and (4) trees growing over or into the channel that impede channel flow. Generally, all trees less than 12 inches in diameter would be removed and trees 12 inches or more in diameter would be saved. Clearing and snagging operations would be conducted so as to prevent damage to any trees, vegetation, or structures outside the designated limits. If, in the opinion of the Contracting Officer, removal of stumps, roots, and matted root growth would tend to undermine or cause excessive erosion of channel banks, such material shall be left in place or would be partially removed as directed by the Contracting Officer. The removal of natural shoals, rock formations, islands, or sandbars is prohibited. In general, the intent is to require the removal of debris and material which would significantly retard flow within the channel. It is the further intent to maintain the tree canopy over Cow Castle Creek to provide stream shade.

6. Living firmly rooted trees growing on bank slopes which do not impede flow would not be removed. Trees to be left will be selected and marked by the Government before clearing is begun. Stumps firmly imbedded in banks would not be removed, but stumps undercut by water action would be removed, leaving imbedded roots in place. Snagging and clearing is not required in backwater areas except where mouths of side channels entering the creek can be identified as such. Obstructions would be removed from the mouths of the side channels so that these areas will be more accessible to fish resources.

7. When cables are attached to trees for bracing or any other purpose, care would be taken to insure that the trees are protected from damage by some means such as wooden shims which would keep the cable from resting directly on the bark or trunk. Care would be taken to prevent damage to

fences, roads, bridges, and other improvements in the work area. Design of the Corps project would be based upon the recommendation contained in U. S. Fish and Wildlife Service Report "Recommendations" found in Appendix D of this report.

DISPOSAL OF MATERIAL

GENERAL

8. All timber, logs, stumps, roots, brush, debris, and other refuse resulting from the clearing and snagging operations would be collected and removed from the stream and right-of-way limits. The material would become the property of the contractor and would be hauled from the site. At the discretion of the Contracting Officer, selective burning may be allowed.

DISPOSAL

9. The contractor would not dispose of material in the stream, on its banks, or elsewhere within the flood plain. All material resulting from the clearing and snagging operations would be removed from the stream and transported out of the flood plain. Methods of disposing of the debris and disposal sites would be outlined in specifications at a later date.

MAINTENANCE PROGRAM

GENERAL

10. While the Corps does not participate in any phase of the maintenance program, other than annual inspection, it is understood that the local interests would use these plans as a general guide for their maintenance program. The maintenance manual would be provided the local sponsor after maintenance work is performed. Methods of maintenance would be left to the discretion of the sponsors. Permits from the Corps may be needed before maintenance if performed. When maintenance is planned, a request for information concerning the necessity of application for permits for maintenance should be made to the Charleston District Engineer.

HERBICIDE ALTERNATE

11. The Cow Castle Creek area has the following vegetation types: Dogwood, Pivet, Honeysuckle, Poison Ivy, Virginia Creeper, Rushes, Plantains, Duckweed, Alligator Weed, and Smartweed. Control and maintenance of undesirable hardwood shrubs could be accomplished through the use of EPA registered herbicide. A maintenance program would involve three applications of the herbicide 2, 4-Damine (4lbs/gal. A.E.). The herbicide would be applied with ground spray equipment at the rate of 1.5 gallons per acre, mixed with enough water (100 to 200 gallons) to insure adequate coverage of the target species. The first application would be in early spring, as soon as leaves develop. A second application six weeks later and a third during mid-summer would complete the program. An anti-drift adjunct (Nalcotrol) would be used to prevent drift of the herbicide outside the treatment area.

APPENDIX D

US Army Corps of Engineers
Charleston District

COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA

PERTINENT CORRESPONDENCE

APPENDIX D

PERTINENT CORRESPONDENCE

TABLE OF CONTENTS

OFFICE OF
ORANGEBURG COUNTY COUNCIL
P. O. DRAWER 589
ORANGEBURG, S. C. 29115

GARY A. SMOAK
County Administrator

April 7, 1981

Lt. Col. Bernard Stillman
Charleston District Engineer
P. O. Box 919
Charleston, S. C. 29402

RE: Request for Reconnaissance Survey Under
Section 205 for the Cow Castle Drainage District

Dear Lt. Col. Stillman:

The Orangeburg County Council is most concerned about the flooding occurring in the south central portion of our county known as the Cow Castle's Drainage District. Not having the financial resources to adequately address the needed channelization in the Cow Castle Creek area, Orangeburg County is hereby petitioning the Army Corps of Engineers to conduct the preliminary reconnaissance survey to determine if our flooding problem is eligible for assistance under the authority of Section 205 of the 1946 Flood Control Act.

The County of Orangeburg is most aware of the local sponsors commitment to fill ~~all~~ requirements of the formal written agreement to be made with the Secretary of the Army.

For your information, a map of the Cow Castle Drainage District is enclosed. The nature and scope of the flood problem will be communicated through our County Engineer, Mr. R. W. Grubbs.

We are most interested in getting the first steps underway in alleviating this problem plaguing our citizens. Thank you for your time and consideration of this matter.

Sincerely,

Fred C. Mack

Fred C. Mack, Chairman
Orangeburg County Council

FCM:cm
Enclosure
cc: Mr. David Harris

OFFICE OF
ORANGEBURG COUNTY COUNCIL
P. O. DRAWER 589
ORANGEBURG, S. C. 29115

GARY A. SMOAK
County Administrator

MEMBERS
FRED C. MACK,
Bowman, S.C. 29018
VERNON OTT, JR., CHM.
Branchville, S.C. 29432
Jackie Fogle
Livingston, S.C.
CHAPEL M. DAVIS JR.
Vance, S.C. 29163
F.G.S. EVERETT
Orangeburg, S.C. 29115
James McGee
Orangeburg, S.C. 29115
JAMES F. WALSH
Orangeburg, S.C. 29115

February 8, 1983

Mr. Bernard E. Stalmann
LTC, Corps of Engineers
District Engineer
Department of the Army
P.O. Box 919
Charleston, S.C. 29402

Dear Colonel Stalmann,

Please be advised that I have your letter of 1 February, 1983 addressed to Mr. Fred C. Mack, Chairman of the Orangeburg County Council, indicating the proposed plan of action on the clearing and snagging of Cow Castle Creek over a distance of one and one-half miles and the cleaning out of Even Branch Trubutary.

This letter will serve as the County Council's letter of intent to supply the necessary contributions at approximately $26,000 for the project under the traditional rules incorporated in the cost sharing requirements of sponsorship. Should it be necessary to implement the innovative financing requirements, a decision concerning sponsorship will be made at a future time when more definitive information is supplied to the County Council. It is our understanding that a part of these requirements or funds may be met by inkind work and donations from land holders and community organizations. We further propose to use whatever cash funds which may be required for this project from the Cow Castle Drainage Fund, which has been set up for some years and is on deposit with the Orangeburg County Treasurer. In the event that more funds are needed than this, County Council has authorized up to $6,000 in addition to those funds currently held on deposit. This should more than adequate to cover the cash outlay that the County will be expected to provide under the traditional rules of cost sharing.

We thank you for the Corps study and for the effort which has been put forth. We are confident that this project will be federally funded and that we will all benefit from the work which will be done in the immediate future.

Sincerely,

Gary A. Smoak

Gary A. Smoak
County Administrator

cc: Members of Orangeburg
County Council

FINAL FISH AND WILDLIFE

COORDINATION ACT REPORT

COW CASTLE CREEK

May 1981

Prepared by:

Prescott H. Brownell, Fish and Wildlife Biologist
Division of Ecological Services
Charleston, South Carolina
Under the supervision of
Roger Banks
Field Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P.O. BOX 12559
217 FORT JOHNSON ROAD
CHARLESTON, SOUTH CAROLINA 29412

July 12, 1983

Lt. Colonel F. Lee Smith, Jr.
District Engineer
U.S. Army Corps of Engineers
P.O. Box 919
Charleston, South Carolina 29402

Dear Colonel Smith:

Attached is our final Fish and Wildlife Coordination Act Report on the Cow Castle Creek small flood control study being conducted by the Charleston District Corps of Engineers. This study was accomplished pursuant to the requirements of Section 208 of the 1948 Flood Control Act. This letter and report are submitted under the authority of and in accordance with Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and should be forwarded to Division with the final Detailed Project Report. The recommendations presented do not differ substantially or in detail from those presented in our draft report. The report was prepared in cooperation with the Environmental Protection Agency (copy of letter attached) and the S.C. Wildlife and Marine Resources Department.

We appreciate the spirit of cooperation displayed by members of your staff during our participation in the planning process.

Sincerely yours,

Roger Banks

Roger L. Banks
Field Supervisor

RLB/PB/lm

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA GEORGIA 30365

JUN 23 1983

4PM-EA/WI

U.S. Department of the Interior
Fish and Wildlife Service
P.O. Box 12559
217 Fort Jackson Road
Charleston, S.C. 29412

ATTENTION: Prescott H. Brownell

SUBJECT: Fish & Wildlife Coordination Act Report
Cow Castle Creek Flood Control Study
Orangeburg County, S.C.

Dear Sir:

Our review of the subject report indicates that it is generally consistent with our views on the project. Strict zoning and building code provisions are necessary to ensure the success of the plan in the long term and we are pleased to see that they are to be included in the proposed plan.

We appreciate the opportunity of reviewing your report.

Sincerely yours,

Arthur G. Linton, P.E.
Federal Activities Coordinator
Environmental Assessment Branch

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

At the request of Orangeburg County Council the Charleston District, U.S. Army Corps of Engineers initiated a flood control Reconnaissance Study on Cow Castle Creek in September 1981. The reconnaissance study was accomplished pursuant to the requirements of Section 208 of the 1948 Flood Control Act and a Reconnaissance Report was completed in May 1982. The following report is provided to the U.S. Army Corps of Engineers in fulfillment of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

This report and the findings and recommendations it contains has been circulated for review by the South Carolina Wildlife and Marine Resources Department and the U.S. Environmental Protection Agency. The comments provided by these agencies, reflecting their concerns and recommendations, have been incorporated into a final report.

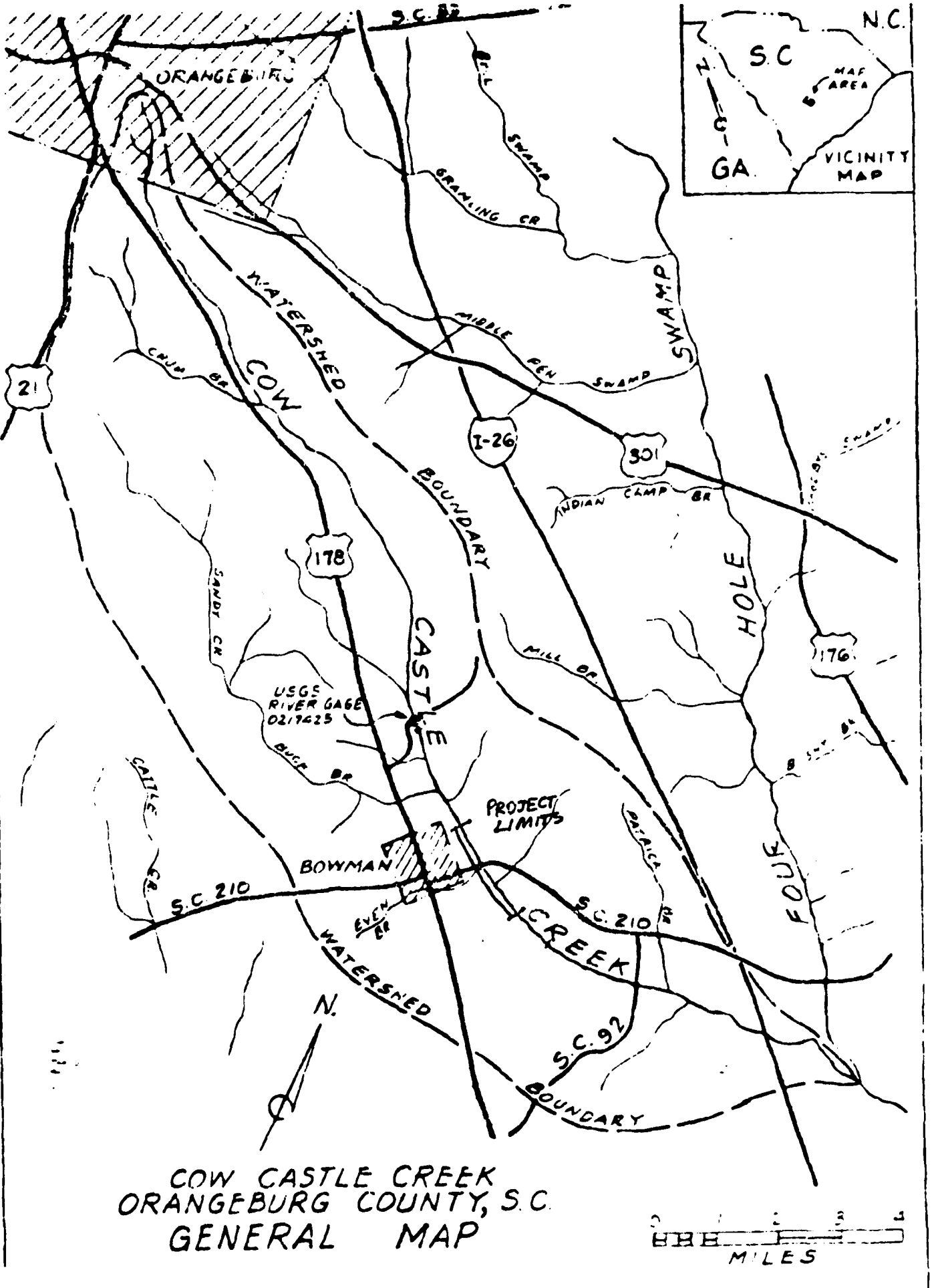
The U.S. Fish and Wildlife Service has commented previously upon the fish and wildlife resources within the area influenced by this project. On January 22, 1982 the Service provided a letter report briefly describing fish and wildlife resources of the Cow Castle Creek basin as a planning aid to facilitate development of environmentally sound flood control alternatives. A draft FWCA report was provided on May 17, 1983.

DESCRIPTION OF THE STUDY AREA

The Cow Castle Creek watershed is located in Orangeburg County, South Carolina, and includes approximately 60 square miles of drainage area (Figure 1). From the headwaters in the city of Orangeburg, Cow Castle Creek flows approximately 17 miles to its confluence with the Four Hole Swamp. The watershed area is located in the upper coastal plain and is characterized by relatively flat topography with broad ridges and wide riparian floodplains. Extensive areas of agricultural lands interspersed with forested land border the Cow Castle Creek floodplain. Urban development includes the town of Bowman (1980 population 1,137) and a small portion of Orangeburg. Cow Castle Creek was channelized during 1944 by the Santee Construction Company with the support of local taxation. During the years intervening since the project was completed the creek channel has gradually returned to a near-natural configuration. The Cow Castle Creek ecosystem has recovered almost completely in response to the natural forces of erosion, deposition, and revegetation.

FLOOD DAMAGES

Flood damages have occurred primarily within the town of Bowman and along U.S. Highway 178. Damages have occurred on residential,



COW CASTLE CREEK
ORANGEBURG COUNTY, S.C.
GENERAL MAP

FIGURE 1

commercial, and agricultural properties. According to Corps field studies, estimated average annual flood damages are approximately $17,000.

FLOOD CONTROL PLANS

Several potential flood control plans have been considered during the duration of Corps studies on Cow Castle Creek. Large-scale measures such as channelization and levee construction were excluded early in planning due to environmental impacts and cost considerations. Non-structural alternatives including relocation of structures and flood-proofing were considered but excluded because of high cost. The recommended plan considered in the remainder of this report represents a scaled down version of the plan emphasized in the Corps' Reconnaissance Study of May 1982. That plan consisted of clearing and snagging above and below Bowman for a total linear distance of 21,000 feet, and a width of 80 feet.

THE RECOMMENDED PLAN

In consideration of the potential environmental impacts as well as flood control costs and benefits, current project plans have been scaled down considerably in scope. The recommended plan provides for clearing and snagging 8,000 feet of the creek channel adjacent to Bowman as shown in Figure 1. In addition the floodplain is to be selectively cleared for a width of 200 feet on the northeast side of and including the existing channel. After completion of the project all maintenance is to be conducted by the local sponsor. The recommended plan is to include zoning and building code provisions to ensure control on development within the floodplain.

EXISTING FISH AND WILDLIFE RESOURCES

upland areas within the Cow Castle Creek watershed are primarily devoted to agriculture. The creek floodplain as well as its tributaries provide high quality refuge for a variety of wildlife including game species. Because of the extensive areas of cropland development and relatively small areas of forested upland, the floodplain forest communities are particularly important to wildlife species that require extensive forest tracts for refuge and breeding habitat. Cow Castle Creek and its tributaries provide high quality habitat for a variety of fish species adapted to small coastal plain streams.

RIVERINE ECOSYSTEM

Cow Castle Creek is a slow flowing upper coastal plain stream with an

alluvial floodplain. The channel is straight and narrow with a uniform width of between 20 and 30 feet for the lower 8 miles above Four Hole Swamp. The straightened alignment of the channel is a result of channelization during 1944. The present stream character is now essentially that of an unaltered stream.

The existing stream character can best be described as R2UB2 or riverine lower perennial, unconsolidated sand bottom, in accordance with the classification scheme proposed by Cowardin, et al (1979). In the vicinity of Bowman stream flow varies from less than 24 cfs during summer drought periods to annual peaks of from 188 to 2,340 cfs during tropical storm events and high spring flows.

Cow Castle Creek is relatively free from water quality impacts of urban or industrial development. The state water quality classification for the Four Hole Swamp drainage is class B. Cow Castle Creek appears to be free from significant siltation impacts and provides high quality stream habitat for fishes adapted to small coastal plain streams.

A stream survey for Cow Castle Creek conducted by the South Carolina Wildlife and Marine Resources Department in 1978 revealed good populations of game species including largemouth bass (Micropterus salmoides), redbreast (Lepomis auritus), and redfin pickerel (Esox americanus). Other species of importance included dollar sunfish (L. marginatus), spotted sunfish (L. punctatus), redear sunfish (L. microlophus), creek chubsucker (Erimyzon oblongus), coastal shiner (Notropis petersoni), and pirate perch (Aphredoderus sayanus).

Important aquatic invertebrates are likely to include dragonflies, midges, crayfishes, unionid clams, and snails.

PALUSTRINE ECOSYSTEM

Within the project area the Cow Castle creek floodplain varies in width from 0.3 mile to 0.5 mile at the downstream end. The floodplain forest includes primarily two forested wetland types: PF01A (bottomland hardwood) and PF01/2C (tupelo-cypress).

PF01A: Bottomland hardwood forest. This type is characterized as Palustrine forested wetland, temporarily flooded. Canopy tree species in order of apparent dominance include laurel oak, swamp chestnut oak, sweetgum, and cherrybark oak. Subcanopy species include red maple, green ash, ironwood, black gum, overcup oak, American elm, and river birch. Shrub layer species include red bay, sweet bay, hobblebush, red buckeye, dwarf palmetto, green alder, greenbriers, and cane.

PF01/2C: Tupelo-cypress. This type occurs in scattered areas where old creek channel segments and tributaries cross the floodplain. Canopy trees include water tupelo, swamp tupelo, and bald cypress. Herbaceous aquatic plants include lizards tail, arrow arum, mermaid-weed, and duckweed.

Fauna of the floodplain forest types likely includes a variety of bird species such as the wood duck, green heron, great blue heron, prothonotary warbler, red-shouldered hawk, barred owl, wild turkey, and the Carolina wren. Mammals likely include the raccoon, mink, cotton mouse, Eastern woodrat, Eastern cottontail rabbit, gray squirrel, and the white-tailed deer. Herptile species may include such species as the Eastern mud turtle, brown water snake, red-bellied water snake, the cottonmouth, anoles, Eastern box turtle, cricket frogs, and river frogs.

UPLAND ECOSYSTEM

Rising from the floodplain of Cow Castle Creek the bottomland hardwood forest gradually grades into a zone of pines and mixed hardwoods near the edge of agricultural lands. Loblolly pine predominates in some areas while hardwoods such as laurel oak, sweetgum, white oak, yellow poplar, red maple, and mockernut hickory dominate the canopy in other areas. The upland ecosystem is beyond the scope of the current project, but the upland forest areas are extremely important habitats for wildlife species.

ENDANGERED AND THREATENED SPECIES

Official lists of species afforded protection under the Endangered Species Act of 1973 have been provided to the Charleston District, Corps of Engineers. The list provided by the U.S. Fish and Wildlife Service by letter of October 15, 1982 identified the red-cockaded woodpecker (Picoides borealis) (Status: Endangered) and the Carolina trillium (Trillium pusillum var. pusillum) (under status review) as species that may occur in the project area. The National Marine Fisheries Service, by letter of October 19, 1982, identified the shortnose sturgeon (Acipenser brevirostrum) as potentially occurring in the project area.

EFFECTS OF THE PROJECT ON FISH AND WILDLIFE RESOURCES

Clearing and snagging is to be conducted within the creek channel and the adjacent floodplain over an approximately 7,900-foot reach of the Cow Castle Creek. The project reach extends from State Road 36 downstream to a point approximately 3/4 mile below State Highway 210 (Figure 1).

Habitats present in the Cow Castle Creek project area are depicted in Figure 2. Approximately 37 acres of floodplain forested wetland would be affected by selective clearing, and approximately 10 acres of the existing creek channel would be cleared of debris and obstructions.

Typical clearing and snagging projects conducted in past years have involved total removal of channel debris and clearing all vegetation from one or both sides of the stream. Use of heavy equipment including dragline and bulldozers for clearing has resulted in significant adverse floodplain and stream impacts.

Impacts of clearing and snagging include the following:

1. Elevation of stream water temperatures due to removal of shade-providing trees. This may result in reduced habitat suitability for fish species as well as changes in species composition and abundance of aquatic insects used as food sources by fish.

2. Sedimentation may occur in significant areas of the stream resulting in destruction of fish spawning and feeding habitats. Sedimentation may result from disturbance of floodplain sediments in the cleared area as well as on equipment access corridors.

3. Destruction of microhabitats vital to aquatic invertebrates and fishes feeding on them. Removal of streamside vegetation and debris reduces habitat diversity as well as further contributing to high turbidity.

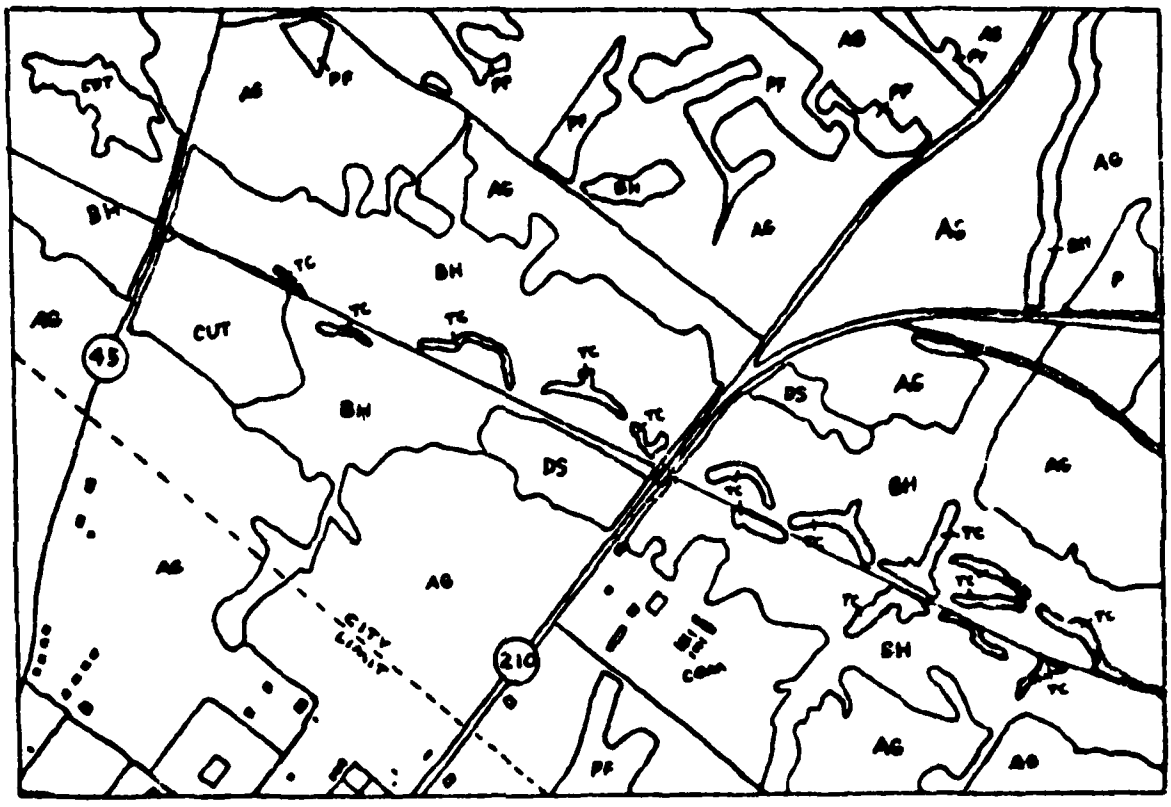
4. Destruction of floodplain forest communities vital to many bird, mammal, and reptile species as feeding, refuge, and reproductive habitat.

DISCUSSION

In general the effects of clearing and snagging projects are much less devastating to riparian ecosystems than channelization. However, the impacts of traditional clearing and snagging projects as presented above may be highly significant for several years after project completion. During recent years considerable progress has been made in development of environmental impact mitigation measures that can be successfully applied to clearing and snagging projects.

The current plans and impact mitigation measures that have been developed for the Cow Castle Creek project will significantly reduce the impacts discussed above if properly monitored and controlled. The recommendations presented in the next section are the result of close

COW CASTLE CREEK HABITATS



AG	AGRICULTURE
BH	BOTTOMLAND HARDWOOD
TC	GUM-CYPRESS
PF	PINE FOREST
DS	DECIDUOUS SHRUB
P	PASTURE

Figure 2.

coordination with the Corps' study team and the S.C. Wildlife Marine and Resources Department.

RECOMMENDATIONS

The following recommendations are based in part on the guidelines developed by McConnell et al. (1980) for the Wolf River project in Tennessee.

A. Materials to be removed from channel

1. Snag and debris removal should be accomplished only where significant ponding or sediment deposition is evident.

2. Affixed logs. Isolated logs should not be disturbed if they are not subject to displacement by current and are not blocking flows. These provide needed habitat diversity for invertebrates and fishes but do not contribute significantly to flow impediments.

3. Small debris accumulations. These should be left undisturbed unless they are collected around a blockage that should be removed. Small debris includes materials that would tend to disperse after larger snags are removed.

4. Stumps should be left intact unless they are detached and subject to movement by current.

5. No excavation should be conducted within the existing channel. Excavation should not be required within the project reach since no significant sediment plugs are present.

B. Procedures and Equipment

1. Logs and debris should be removed by hand equipment if possible. Where this is not possible, small motorized equipment such as a D-4 size tractor with winch should be used to drag logs from the floodplain. A small tractor should be able to maneuver in the floodplain without requiring the cutting of trees over 12-inch diameter at breast height (dbh).

2. Access routes for equipment should be selected to minimize disturbance to floodplain trees. Equipment should be selected which can maneuver without tree removal.

3. Log disposal. All logs or trees removed from the stream or floodway should be moved out of the floodway and burned or secured so as to prevent re-floating.

4. Clearing must be restricted to the northeast side of the channel to preserve shading as much as possible. This practice should prevent excessive elevation of stream temperatures in summer.

5. All trees greater than 12-inch diameter at breast height should not be cut unless they are dead and likely to fall into the channel or floodway within one year. Den trees should be protected if at all possible.

6. All work should be completed during late summer or fall to reduce siltation impacts on aquatic life.

C. Reclamation measures

1. All disturbed areas should be reseeded with plant species which will help stabilize soils and provide some benefit to wildlife.

D. Maintenance guidelines

1. Use of herbicide to control re-growth of shrubs should be closely regulated. An EPA registered herbicide approved for aquatic use should be applied with hand ground spray equipment and in conjunction with an anti-drift adjunct. Spray should be applied only during no-wind conditions.

2. Any maintenance work should conform to the guidelines presented above for the initial project.

CONCLUSIONS

The Cow Castle Creek project has been reduced considerably in scope during the planning process. The original project would have impacted 4 miles of the creek channel and floodplain. The present project reach will directly affect 1 1/2 miles of the riparian system. close cooperation between the Service and the Corps' study team, as well as the S.C. Wildlife and Marine Resources Department has resulted in a project design less destructive of fish and wildlife resources. If we must see a flood control project on Cow Castle Creek, the current plan represents our best efforts to reduce adverse effects on fish and wildlife resources.

Recommended Literature on Stream Renovation

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1978. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31, U.S. Fish and Wildlife Service, Washington, D.C. 103 pp.

East, B. 1977. Make the river do the work. Outdoor Life. 161(10): 78-81, 152.

Karr, J. R. and I. J. Schlosser. 1978. Water resources and the land-water interface: water resources in agricultural watersheds can be improved by multidisciplinary planning. Science 201: 229-234.

McConnell, C. A., D. R. Parsons, G. L. Montgomery and W. L. Gainer. 1980. Stream renovation alternatives: the Wolf River story. J. Soil and Water Conserv. 35(1): 17-20.

White, T. R., and R. C. Fox. 1980. Recolonization of streams by aquatic insects following channelization. Water Resources Research Institute, Clemson Univ. Tech. Report 87(1). 120 pp.

APPENDIX

US Army Corps of Engineers
Charleston District

COW CASTLE CREEK
ORANGEBURG COUNTY, SOUTH CAROLINA

CULTURAL RESOURCES STUDY

SADPD-R 29 April 1983

CULTURAL RESOURCES RECONNAISSANCE OF COW CASTLE
CREEK FLOOD CONTROL PROJECT AREA, ORANGEBURG COUNTY, SOUTH CAROLINA

1.0 Project Description. The proposed Cow Castle Creek Flood Control project would be located in Orangeburg County, South Carolina, immediately north of the community of Bowman, along Cow Castle Creek. The recommended plan would consist of snagging the existing channel and clearing the river left (south) bank of restrictive undergrowth and small trees. Total project length would be 1.5 miles; width would be about 200 feet. An estimated 37 acres of land would be affected.

2.0 Project Area Environment (see Environmental Assessment for more detailed description and maps.) The entire area which would be impacted by project activities is low-lying palustrine forested wetland, dominated by a bald cypress-water tupelo community. The only elevated terrain which exists within the impact area is mounds of material immediate adjacent to the streambank resulting from the dredging of Cow Castle Creek in 1944 by the Cow Castle Water District of Orangeburg County.

3.0 Cultural Resources Field Reconnaissance. A field reconnaissance of the area to be impacted was conducted on 4-5 April 1983. A literature review revealed that no National Register or other cultural properties are recorded for the project area. Field investigations also revealed no evidence of past or present human occupation of the area. Limited test excavations were conducted in an effort to locate higher land elevations which might have been suitable for prehistoric habitation sites. However, it was quickly confirmed that the entire impact area is severely flood-prone and, therefore, not amenable to habitation. No potentially significant cultural resources of any type will be impacted by the proposed work.

MARC D. RUCKER
Archeologist
South Atlantic Division

END

FILMED

9-83

DTIC